



# INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

## BLOCKCHAIN IN ENERGY SECTOR

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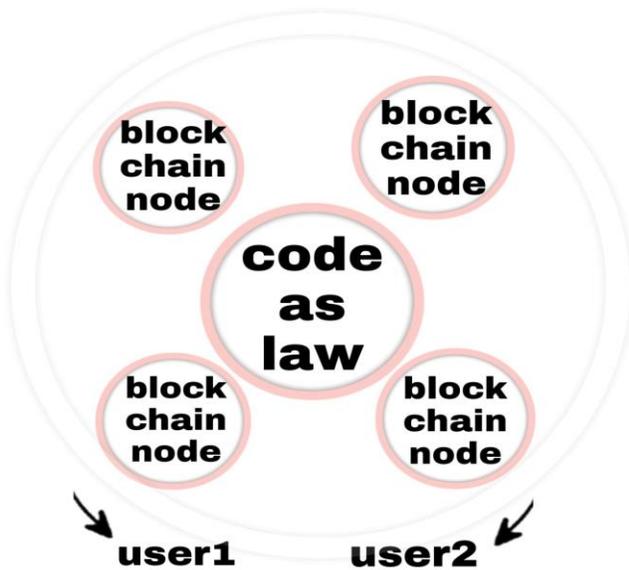
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**ABSTRACT:** Blockchain is an emerging technology that has drawn considerable interest from many different firms, sectors, startups, developers, government, financial and educational institutions. Blockchain has a great amount of potential. Blockchain technology also holds the potential to revolutionize the energy sector. There has been a lot of innovation in the energy sector, but still, the most used technology in energy generation uses non-renewable resources and leads to its faster depletion. Even after so many innovations, renewable energies are just not able to completely replace or even reduce greatly the use of non-renewable resources. But blockchain is a technology which can make this possible. In this paper, we will study about blockchain and how it can help to revolutionize the energy sector.

Keywords: Blockchain, Energy Sector, Non-Renewable Resources, Renewable Resources

### 1. INTRODUCTION

Blockchain has immense potential. It won't be wrong to say that blockchain is one of the most revolutionary ideas in the field of information technology, and has capability to change how things will be working in better and more secure ways. A **blockchain**, <sup>[1][2][3]</sup> is a growing list of records, called *blocks*, that are linked using cryptography. <sup>[1][4]</sup> Each block contains a cryptographic hash of the previous block, <sup>[4]</sup> a timestamp, and transaction data (generally represented as a Merkle tree). By design, a blockchain is resistant to modification of its data. This is because once recorded, the data in any given block cannot be altered retroactively without alteration of all subsequent blocks. For use as a distributed ledger, a blockchain is typically managed by a peer-to-peer network collectively adhering to a protocol for inter-node communication and validating new blocks. Blockchain have a lot of use cases. Some of the major use cases of blockchain are those which are proving themselves to be revolutionary in the Energy Sector. Non-Renewable resources are getting depleted, and renewable resources are not powerful enough to take over nonrenewable resources completely or even by 50%, if traditional grid is continued to be used. But blockchain technology can solve this problem. It can also help reduce the usage of nonrenewable resources quite greatly. <sup>[5]</sup> Current blockchain designs run on algorithms that can consume up to 215 kWh per transaction (i.e., the equivalent of letting an incandescent light bulb of 25W burn for a full year)<sup>[6]</sup>In 2018, one third of the top 250 energy companies in the Platts ranking publicly reported their involvement in at least one blockchain project.



BLOCKCHAIN AS DISTRIBUTED LEDGER.

## 2. TRADITIONAL GRID

Traditional grid we are talking about is the grid that is the most commonly used grid in the world for energy generation. This grid is not as efficient as grids which use blockchain technology. <sup>[7]</sup> The power grid is an electrical network consisting of electrical cables, switch gears, and transformers, as well as the connected generators and consumers. The main feature of this grid is the unidirectional flow of power that happens. Power is transferred in different levels of voltages to reduce losses. [Extra-high voltage (380 kV/220 kV, transmission network), high voltage (110 kV, supra-regional distribution networks), medium voltage (10 kV–30 kV, regional distribution networks), and low voltage (0.4 kV, local distribution networks)]. Power supply from the power house is connected to transformers. Balance of consumption and generation of energy always needs a balance as there is no solution to store the energy that is being generated. This is a constant challenge for the grid. Although this problem may continue to be there in future, but Blockchain technology use-case grid can certainly make power saving more feasible.

## 3. USE CASES OF BLOCKCHAIN IN ENERGY SECTOR

### 3.1. PEER TO PEER ENERGY TRANSFER

Peer to Peer Energy transfer which is one of the major use case of blockchain in the energy sector and also the most successful one. Peer to Peer Energy transfer is seen to be that one use case which is expected to have the highest success rate and use in future as it is something which takes advantage of even the energy generated at smallest of all the levels. Peer to Peer energy transfer allows people or organizations to transfer and receive energy from each other in case of extra energy that is generated by them. Peer to Peer already has many successful implementations. Two of them are Brooklyn Microgrid project and Lition Energy P2P platform project. These two are further explained in detail. There are also many companies who have set their base work on this technology. <sup>[8]</sup> Some companies who are currently on different Peer to Peer projects are LO3 (Brooklyn Microgrid Project), Sonnen Flat, PowerLedger, Grid+, SunContract, Ponton and many more of them.

### 3.2 SMART GRID

As global cities are constantly expanding to accommodate population growth, the need to provide infrastructure support is also increasing and with this there is increased demand for electricity as well. <sup>[9]</sup> Deployment of the smart grid helps cities manage their energy needs. Smart grids are the electricity grids for modern energy demands. Now, what makes a grid smart? <sup>[10]</sup> Classical grid (power grid) works on one-way communication that consumers bought power via energy companies (single power plant) whereas smart grid allows two-way communication that is a direct transaction between generators and consumers. Smart grid uses advanced information and communication systems to connect power generators, distribution stations, and consumers to respond digitally and quickly to changing electric demands. Smart grid has the potential to help us reach carbon reduction and renewable energy goals, improve economic efficiency and improve power distribution.

Smart grid offers more security in terms of electricity supply, <sup>[11]</sup> for example when a consumer pays for electricity then who will monitor that generators are delivering the electricity and who will validate the transaction, so this is where blockchain needs to be implemented to address fraudulent issues.

Smart grid because of its two-way interactive capacity can help rerouting electricity during emergency situations like earthquakes, storms etc. <sup>[12]</sup> Its technologies will detect and help ensure that electricity recovery resumes quickly and strategically after an emergency. It also ensures to route electricity in emergency services first like health centers, police departments, traffic lights, phone systems, and grocery stores via taking greater advantage of customer-owned power generators to produce power when it is not available from utilities.

### 3.3 ONE WORLD ONE SUN ONE GRID

This plan is devised by Indian government to connect Indian solar grid to other western and eastern countries. As solar energy can't be stored, thus it's not possible to power one nation even if thousands of solar plants are installed. The problem arises at night time as there is no solar energy being generated at night time. But this problem can be solved if the world comes together, help each other and gain from each other. So, as a solution to this problem, it is being planned to connect the solar grid all across the world which provides power to the whole world. The main principle of this plan is that if it is day in one part of the world and night in another part, the energy is being shared alternatively such that all the countries on the grid will get the power supply, no matter it is day or night. In this new plan blockchain may also play an important role as it may help to keep a store information of points on the grid and all the power transactions that will happen in the grid. It is stated that <sup>[13]</sup> "Till now solar energy acted as a supplementary source to the conventional energy sources, but that day is not far when the whole world will be connected by a single grid of solar power as a primary source of energy". This can bring a great revolution in the power sector. This will also help to reduce the power bills to a great extent and also help to provide 24x7 electricity supply to many deprived parts of the country.

Although Australia is also implementing the OSOWOG project, <sup>[14]</sup> India has its advantage over Australia in case of this project because of their geographical coordinates. Right now ISA (International Solar Alliance) is concerned agency to implement OSOWOG project in India. India is also inviting companies to bid for this project. Although this project has some problems which may be faced by the implementing authority, blockchain technology can solve at least few of them.

### 3.4 ELECTRIC VEHICLE CHARGING AND SHARING

Peer to peer is one of the main feature of blockchain. This feature can be helpful to encourage use of more electric vehicles which create less pollution and also cuts on use of petroleum which is depleting at an immense rate. One of the main problems in using electric vehicles is that people fear that they may run out of electric charge in long drives and will eventually come to a helpless state. This is really a big problem with current management of electric vehicle charging. But this problem has a solution. That solution can be implemented using blockchain. Peer to Peer (P2P) feature of blockchain allows general people to share their extra energy to help people charge their vehicles. In return they can earn a decent amount of money through this, which will create an extra income for their household. But how will the involvement of so many people in this chain of charging and sharing will be managed is answered by blockchain. blockchain here will be responsible for keeping information of different people who will be involved in this and how much energy they sell.

## 4. SUCCESSFUL EXAMPLES OF BLOCKCHAIN IN THE ENERGY SECTOR

### 4.1. BROOKLYN MICROGRID

<sup>[15]</sup> Few know that there are some successful implementations of Blockchain technology in the energy sector. First is the Brooklyn Microgrid project that works on the note— "buying energy from the roof next door". <sup>[16]</sup> This lets prosumers (consumers who also are part of energy producers) sell their excess solar energy. <sup>[17]</sup> This helps create an energy marketplace for locally-generated, solar energy. It was started in early 2015 and built on blockchain technology. Here Blockchain technology is used as a platform required to store the transaction data of those connected in the network and secondly that data should be secure i.e. resistant to data manipulation which can be achieved through blockchain technology as it stores the data in decentralized manner.

### 4.2. LITON ENERGY P2P(PEER-TO-PEER) PLATFORM PROJECT

The other blockchain application in the energy sector that is successfully employed is in Germany and called The Lition Energy P2P(peer-to-peer) Platform Project whose motto is "bringing power to the people". <sup>[18]</sup> It was founded earlier in 2018. As the population grows, consumption increases, traditional fuel sources are depleting, electricity and heating costs become a burden on ordinary people. Providing a helping hand, Lition Energy is a licensed energy supplier which connects producers and customers directly through blockchain based energy exchange to carry out energy purchase and sale transactions without intervening through third parties and thus lowering the costs and making the market more transparent. <sup>[19]</sup> This project is partnered with SAP. Two networks were created that sustain the entire operation. Public data stores in Ethereum network and the platform stores the customer's critical data on private side chains which can be deleted and stored only as long as it is necessary.

## 5. FUTURE OF BLOCKCHAIN TECHNOLOGY IN ENERGY SECTOR

For Energy Web's Decentralized Operating System (EWDOS) many other use cases are also under development. <sup>[20]</sup> Among these are enterprise-grade settlement services, distributed resource integration, the growth of geothermal energy in Germany and the advance of token-enabled ecosystems. <sup>[21]</sup> Blockchain in future will be creating a lot of startups in future. This point is also valid for blockchain use in the energy sector. Researchers claim that peer to peer to peer energy trading to be one of the most successful use cases

of blockchain technology in the electric field, as it allows commercial institutions and private consumers both to be producers of electricity as well. Electric vehicle charging and sharing is also claimed to be one of most successful technologies in future as there is immense rise in electric vehicles. Also currently a huge percentage of startups and MNCs are focusing on these two use cases of blockchain. Blockchain use in the energy sector may solve many problems including lack of supply of power all over the world, depletion of nonrenewable resources, global warming, reduction of carbon emission, costly power supply and much more.

## 6. CONCLUSION

Blockchain technology is something as revolutionary as the internet and it is something which may completely change what future may look like in almost every field and it as well as comes out to be the future of energy generation and consumption. As nonrenewable resources are depleting at such a pace, it is quite an obvious need to take steps to control its depletion. Also as the population is increasing and countries are developing, demand for energy keeps on growing coupled with this depletion of traditional energy resources. Blockchain comes in use to solve this major problem. We studied various use cases of blockchain technology in the energy sector which are either already in practice or being researched for future uses. These use-cases have the capability to change power production and consumption to an extreme level. Also, there may be many other inventions in the energy sector which will lead to benefits of the human race as well as our mother earth.

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