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Energy Trading through Blockchain

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ABSTRACT
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. The core point of the project is to pay for what is being served. The source and destination stations will be abiding to a smart contract which allows them to pay for exactly the served amount of energy. Each and every transaction is stored in a ledger. Operating the entire system in Ethereum platform provides transparency, security and credibility to the process. The process entirely runs on the transfer of cryptocurrencies and not any other mode of money.

Keywords : Blockchain, Ethereum, Ledger, Smart Contract, Cryptocurrency, Credibility.

I. INTRODUCTION

Blockchains or distributed ledgers are an emerging technology that has drawn considerable interest from energy supply firms, startups, technology developers, financial institutions, national governments and the academic community. Numerous sources coming from these backgrounds identify blockchains as having the potential to bring significant benefits and innovation. Blockchains promise transparent, tamper-proof and secure systems that can enable novel business solutions, especially when combined with smart contracts. It provides a comprehensive overview of fundamental principles that underpin blockchain technologies, such as system architectures and distributed consensus algorithms. Next, we focus on blockchain solutions for the energy industry and inform the state-of-the-art by thoroughly reviewing the literature and current business cases. To our knowledge, this is one of the first academic, peer-reviewed works to provide a systematic review of blockchain activities and initiatives in the energy sector. Our study reviews 140 blockchain research projects and startups from which we construct a map of the potential and relevance of blockchains for energy applications. These initiatives were systematically classified into different groups according to the field of activity, implementation platform and consensus strategy used. Opportunities, potential challenges and limitations for a number of use cases have been discussed, ranging from emerging peer-to-peer (P2P) energy trading and Internet of Things (IoT) applications, to decentralised marketplaces, electric vehicle charging and e-mobility from a basic technical view. A blockchain might not look that different from things you're familiar with, say Wikipedia. With a blockchain, many people can write entries into a record of information, and a community of users can control how the record of information is published and updated. Similarly, Wikipedia entries are not the product of a single publisher. No one person controls the information.

A user (client) with permissions associated with its account is able to change Wikipedia entries stored on

a centralized server. Whenever a user accesses the Wikipedia page, they will get the updated version of the 'master copy' of the Wikipedia entry. Control of the database remains with Wikipedia administrators allowing for access and permissions to be maintained by a central authority.

Based on the theme of decentralized framework and security that is been provided to the transactions that are being done using blockchain technology. The basic purpose of blockchain is to maintain integrity between both the parties while the transaction happens. The transactions done through blockchain are secured as well as immutable. That means the transactions once recorded in a ledger cannot be altered even by it's highest authority. This brings in utmost integrity and accountability to both parties during transaction. Through the application of blockchain technology there is the opportunity to streamline internal processes and processes shared with external market participants. This can fundamentally change the landscape of energy and commodity trading. As solar and battery storage systems increase, more people are talking about peer-to-peer electricity trading. The system allows consumers to take advantage of other users who produce more energy than they need.

II. METHODS AND MATERIAL

A blockchain is a digital data structure, a shared and distributed database that contains a continuously expanding log of transactions and their chronological order. The data structure is in other words a ledger that may contain digital transactions, data records and executables.

A. Taxonomies of blockchain system architecture

A blockchain network or system can follow different rules and system architectures depending on desired operation and specific use case. Blockchain systems are typically consisted of network users and validators. User nodes can initiate or receive transactions and hold a copy of the ledger. In addition to read access privileges, validators are responsible for approving modifications of the ledger and reaching consensus throughout the network regarding the valid state of the ledger. Depending on the system configuration, partial or universal access rights and validations rights may apply. All Internet users can join a public blockchain system. On the contrary, with private blockchains the access is restricted only to authorised participants. Permission less ledgers are completely distributed and censorship-resistant as any member of the network can contribute to the validation of transactions. On the contrary, with permissioned ledgers only certain validator nodes hold write access rights to modify the blockchain with public and permission less ledgers, users and validators are completely unknown to each other, therefore the collaborative effort and trust required for ledger management is induced by game-theoretic equillibria and rewards.

B. Distributed Consensus algorithms

Existing literature describes many types of distributed consensus algorithms being developed, each providing distinctive features, advantages and disadvantages. The methodology used for reaching consensus in blockchain networks determines to a large extent key performance characteristics such as scalability, transaction speed, transaction finality, security and spending of resources such as electricity. Broadly speaking, every method requires a procedure for generating and subsequently accepting a block. A block can be generated or proposed by some node in the network, and it encodes a number of transactions (e.g. in a cryptocurrency system, these are monetary transactions between different accounts). Next, a key step is for the proposed block/corresponding

transactions to be accepted by network members, a process called reaching consensus.

C. Proof-of-Work(POW)

The origins of PoW, used by Bitcoin, can be found in the 'Hashcash' proof of work developed to limit denial of service attacks on Internet resources. Validators or miners compete with each other to add a new block in the existing blockchain by solving a cryptographical puzzle of generating a hash output that starts with a number of consecutive zeros in the most significant positions. The method used adds a nonce, i.e. a random number that can be used once, to the block, and calculates the hash output of the block header. The block header contains information such as the hash of the previous block validated and a special hash of all transactions contained in the block. . Miners have no way to predict or influence the outcome, so the only feasible action is that of trial and error. This brute forcing procedure requires computational effort that increases exponentially with the number of trailing zeros.

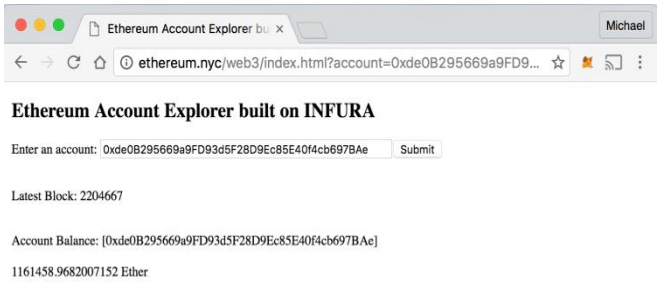
D. Pseudocode for smart contract

```
Contract Trade
{
    address public organizer;
    mapping (address => uint) public registrantsPaid;
    uint public numRegistrants;
    uint public trans;
    // so you can log these events
    event Deposit(address _from, uint _amount);
    event Refund(address _to, uint _amount);
    function Trade() // Constructor
   {
        organizer = msg.sender;
        trans = 500;
        numRegistrants = 0;
    }
    function buyBid() public returns (bool success)
   {
      if (numRegistrants >= trans) { return false; }
       registrantsPaid[msg.sender] = msg.value;
       numRegistrants++;
       Deposit(msg.sender, msg.value);
       return true;
     }
     function changeTrans(uint newtrans) public {
      if (msg.sender != organizer) { return; }
      trans = newtrans;
     }
     function refundAmount(address recipient, uint amount)
public {
      if (msg.sender != organizer) { return; }
      if (registrantsPaid[recipient] == amount) {
        address myAddress = this;
        if (myAddress.balance >= amount) {
          recipient.send(amount);
          registrantsPaid[recipient] = 0;
          numRegistrants--;
          Refund(recipient, amount);
        }
       }
     }
     function destroy()
   { // so funds not locked in contract forever
      if (msg.sender == organizer)
      {
        suicide(organizer); // send funds to organizer
      }
    }
   }
```

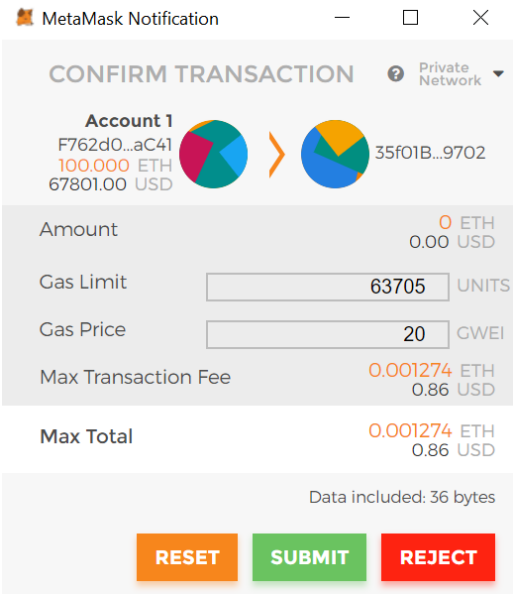
III.RESULTS AND DISCUSSION

Thus, blockchain has served its purpose by implementing a secure and decentralised transaction between the producer and consumer establishing a stable and secured platform for all transaction operations. It does not require any third party resources like ganache and testrpc that are used to generate test ethers. In our topology we generate our own ethers by mining. The blockchain specified in this project is a private blockchain in the sense only specified users can access the chain network. We

used Infura, a hosted ethereum node cluster that lets user to run their application without requiring any further setup for ethereum node or wallet.



We have also used metamask, a browser plugin that allows users to make ethereum transactions on normal websites. It acts as abridge between user interfaces for ethereum and regular webpage.



IV.CONCLUSION

To conclude, blockchain or distributed ledger technologies can clearly benefit energy system operations, markets and consumers. They offer disintermediation, transparency and tamper-proof transactions, but most importantly, blockchains offer novel solutions for empowering consumers and small renewable generators to play a more active role in the energy market and monetise their assets. Blockchains have enabled applications of sharing-economy in the energy sector, which has prompted several authors to speak about novel market models and energy democratisation. Many research and commercial parties are currently pursuing blockchain innovation in the energy sector. Blockchains are a fast-moving area of research and development, therefore a review on this emergent technology is required to improve understanding, inform the body of knowledge on blockchains and realise their potential.

Today's power trading systems are centralized in their processing, so the price is not determined by the principle of demand and supply, and there is even the risk of price manipulation by collusion. In addition, these systems are vulnerable to security problems such as hacking. Recently, the rapid development in blockchain technology is inherently decentralized, and is impossible to tamper the recorded information. Applying this to the problem of asset trading simplifies the process and increases the reliability. Therefore, in this study, we implemented an experimental power trading system to demonstrate the possibility that blockchain can be a good solution.

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