SoK: How Blockchain and Tokenization Will Transform the Energy Sector

***Abstract*—Tokenization and blockchain technology might significantly improve the energy industry by making electricity production, transmission, and consumption more open, safe, and effective. Tokenization enables the establishment of digital assets that reflect ownership or access to energy resources and enables blockchain to trace the origin and flow of energy produced. By incorporating these elements, we can build a more distributed and egalitarian energy infrastructure and make it easier to use renewable energy. However, legal barriers, integration with current systems, and scalability remain obstacles to the widespread use of these technologies in the energy industry. Therefore, there is a need for more study and development before the energy industry can ultimately reap the benefits of blockchain and tokenization. Accordingly, in this work, we suggest a systematization of knowledge to capture recent development and summarize research in the blockchain domain and its application to the energy sector.**

***Index Terms*—Blockchain, Energy, Tokenization, DLT**

I. Introduction

Growing interest in blockchain technology's potential to transform various industries has led to increased research and development [1]–[4]. Blockchain's decentralization enables secure, transparent transaction records without a centralized authority, impacting industries like finance, supply chain management, and energy [5]–[7].

Two main categories of distributed ledger technology exist: permissionless (public) and permissioned (private) blockchain networks. Permissionless networks, like Bitcoin [8] and Ethereum [9], are decentralized and open to everyone. In contrast, permissioned networks require permission from a governing body to participate and are used when privacy and control are needed.

Blockchain technology can revolutionize the energy sector, facilitating renewable energy grid integration and balancing supply and demand. By allowing customers and producers to buy and sell excess renewable energy, the technology can help balance the grid and reduce fossil fuel use.

Additionally, blockchain technology can contribute to the development of "smart grids," enhancing their effectiveness, reliability, and sustainability by enabling real-time data exchange across grid components. This can lead to better resource utilization and integration of emerging technologies like electric vehicles. Furthermore, blockchain technology can provide a secure, open-source platform for trading carbon offsets and energy credits, supporting the transition to a low-carbon economy. In this work, we aim to collect and systematize studies in the blockchain and energy tokenization domain [10] to outline recent results, compare available solutions, and explore applications within the energy sector.

A. Structure

The remaining part of the paper proceeds as follows: II. Background, III. Related work, IV. Methodology, V. Tokenization cases, VI. Conclusion, VII. Appendix I. Chapter II. Background begins by laying out the theoretical dimensions of the blockchain technology. Chapter III. describes the methodology used for this research (including selection criteria for the sources). The main chapter – V. Tokenization cases: overview and conclusions consist of three parts: A. Blockchain use-cases in the energy sector; B. Blockchain projects and initiatives in the energy sector; C. Projects utilizing energy tokens. Finally, the Conclusion gives a brief summary of the findings. The comparative table with main energy token projects is presented in the Appendix I.

II. Background

The concept of data and value transmission is being revolutionized by blockchain technology. A blockchain is fundamentally a decentralized, distributed ledger that enables safe and transparent transaction tracking. Therefore, it has the potential to disrupt and alter several industries, including banking, supply chain management, and the energy industry.

Blockchain is a peer-to-peer network, meaning no central authority or server controls the network. Instead, the network consists of a collection of nodes responsible for validating and recording transactions. Each node has a copy of the ledger, which contains a record of all previous transactions. The ledger consists of an ordered chain of hash-chained blocks, with each new block referencing the preceding block by its hash value. A block on a blockchain is a data unit that comprises a collection of transactions and other data.

Typically, each block in a blockchain has the following structure:

1) **Block header**: This contains metadata about the block, including a reference to the previous block (also known as the "parent" block), a timestamp, and other information.
2) **Transactions**: A block can contain multiple transactions recorded in the block. A transaction is a record of a transfer of value between two parties, and it typically includes information such as the sender and recipient of the value, the amount of value being transferred, and a signature to confirm the transaction's authenticity.
3) **Block hash**: A block hash is a unique identifier for a block, calculated by running the block's data through a cryptographic hash function. The block hash is used to verify the block's integrity and ensure that it has not been tampered with.

A block in a blockchain comprises a collection of transactions, a reference to the previous block, and a timestamp. It is added to the blockchain upon distributed consensus, connecting to other blocks via block hashes. Transaction data is typically represented as a Merkle tree [11], an immutable binary tree structure enabling efficient and secure verification of large data sets. Merkle trees allow clients to verify specific transactions within a block by requesting evidence from the network and checking it using the tree, thus enabling efficient transaction verification without transmitting the entire block.

Smart contracts, crucial components of blockchain systems, facilitate the automation of operations and are used to simplify, validate, and enforce the negotiation or execution of agreements. These contracts can improve efficiency and eliminate intermediaries across various sectors, becoming a vital component of blockchain platforms such as Ethereum [9] and Hyperledger Fabric [12]. Ethereum is a decentralized, open-source blockchain platform running smart contracts and programs without the risk of downtime, censorship, fraud, or third-party interference, while Hyperledger Fabric is a permissioned, open-source blockchain technology designed to be flexible and modular for diverse applications and industries.

Blockchain technology and smart contracts can revolutionize asset management and trading through tokenization [13], which represents physical assets as digital tokens on a blockchain, facilitating efficient and secure asset ownership transfers. Tokenization can disrupt finance, real estate, and supply chain management industries and, in the energy sector, can streamline green energy credit trading and establish decentralized markets. Consensus algorithms, essential for blockchain technology [14], ensure the secure and efficient operation of distributed networks and enable nodes to agree on the blockchain's state while preventing fraud. Examples include Proof of Work (PoW), Proof of Stake (PoS), and Delegated Proof of Stake (DPoS), each with distinct strengths and weaknesses, influencing a blockchain network's speed and security.

III. Related Work

The development of sustainable energy sources and network technology has created new opportunities in the energy industry, while also presenting challenges such as decreased efficiency and management and control issues [15], [16]. A growing body of research indicates that blockchain technology can help overcome these challenges, improve the efficiency of current practices, accelerate Internet of Things (IoT) development, and provide innovative solutions for peer-to-peer (P2P) energy trading [17]. However, some of these studies may be outdated, and current technical limitations and conservative market attitudes could hinder blockchain's potential to transform the modern energy market [18].

The Energy Internet and smart grid innovations, as recent directions in energy development, can benefit from blockchain's ability to address control and management challenges in distributed sustainable energy systems [15]. Researchers have identified specific areas where blockchain technology can improve the energy industry, including energy trading systems, electric vehicle (EV) charging, supply chain tracking, and asset management [19]. P2P energy trading platforms based on blockchain can cut out middlemen, offering the potential for significant market restructuring, although some concerns remain about the technology's scalability and market adoption [18].

Latest research by a group of IEEE scientists demonstrates how blockchain can facilitate efficient resource allocation between energy providers and consumers through P2P trading platforms [20]. These platforms can exist without central authority and provide transparency, security, and trustworthiness. The study presents an Ethereum-based P2P trading platform that enables consumers to obtain energy in a reliable, secure, and cost-effective manner, allowing any entity to act as an energy provider or consumer.

Peng, C., et al. [21] conducted the study and pointed out future research directions regarding the combination of blockchain and vehicular IoT. Discussed both directions of how to improve vehicular IoT protocols to support blockchain and how to design an efficient blockchain system to satisfy the application requirements in vehicular IoT. Knirsch, F. et al. presented in the study - GECKO, a blockchain-based system for green energy certificates. The main actors of proposed system are decribed by scientists in the following way: Distribution System Operators (DSOs), authority which issues the certificates; producer, power plant which produce renewable energy; consumer, who are buying green certificate (certified kWh) and marks consumed certificates. The proposed system is capable of representing verifiable green energy production and consumption through DSO-certified sustainable energy resources with kWh granularity. The GECKO is capable of the following features:

- green energy trading beyond DSO borders through a confirmation-based system;
- scaling to trade within even a very large geographic region with a high percentage of renewable energy resources; and
- being implemented with constant-time complexity for all system events.

As for the type of blockchain, researchers more often implement their proposed energy trading system on Ethereum. J. Yang et al. (a group of Singaporean and Canadian scientists) in their research tried to demonstrate why public blockchain is more suitable for the P2P energy market. Authors compare Hyperledger Fabric and Ethereum and conclude that Ethereum is more suitable platform for P2P transactions in the energy market [22]. While authors admit the benefits of Hyperledger Fabric, they conclude that its structure can be hardly applicable for decentralized P2P trading platforms. In their research authors proposed a fully public chain based on Ethereum which can match the decentralized structure of the P2P market.

At the same time, there are been a limited amount of research that tries to systematize the existing knowledge of blockchain application in the energy sector. Several companies, cases, and trends which were popular in 2017-2018

during the rise of public interest in blockchain technology, have transformed radically or do not exist anymore. The main contribution of this paper is to provide systematized and updated knowledge about the way blockchain is helping to modernize the energy sector.

IV. Methodology

To conduct systematization of the knowledge of the application of blockchain technology in the energy sector we chose research papers that were published in recent years either in high-ranking research journals or as a part of conference proceedings. We were also using research papers references to conduct further search for additional relevant publications.

Articles were searched from 2019 until 2022. The only exceptions were made for the article written by J. Wu et al. which was published in 2018. Although the article seems to be outdated and provide a rather basic overview of most popular use-cases in blockchain, it also provides the concept of the "Energy Internet" and described the real blockchain project – "Juice Net" [15].

As the result, 28 research papers were gathered. Research articles were downloaded from the following electronic scientific libraries Elsevier, IEEE Xplore, Springer, MPDI etc. The papers were ranked in accordance with their Cite.Index by Google Scholar Indexing. We also use other primary (companies official websites and press-releases) and secondary sources (reports of consulting agencies and third parties' statistical data) to verify the information provided in the research papers and gather the latest updates.

V. Tokenization cases: overview

A. Motivation

Blockchain technology presents a revolutionary solution to the energy sector's challenges due to its decentralized, secure, and transparent nature. Its potential applications include facilitating peer-to-peer (P2P) energy trading, enhancing grid security, and promoting the integration of renewable energy sources, ultimately contributing to a more sustainable and resilient energy system.

P2P energy trading is a notable application of blockchain in the energy sector, as it allows consumers to trade surplus energy without intermediaries, fostering local energy generation and consumption. Successful projects like the Brooklyn Microgrid [23] and Power Ledger [24] demonstrate blockchain's potential to create a more participatory, democratized energy market that encourages competition and reduces costs. Furthermore, blockchain can enhance the security and reliability of energy grids by offering an immutable, tamper-proof, and decentralized security framework, which is vital for detecting and preventing unauthorized access to grid resources. Initiatives such as Grid+ [25], Electron [26], and Energy Web Foundation [27] are exploring blockchain's application for grid management and security.

In addition to grid security, blockchain supports the integration of renewable energy sources into the grid. As the world transitions towards cleaner energy solutions, efficient and transparent management of renewable resources is essential. Blockchain platforms can track and verify energy origins, enabling reliable and transparent renewable energy certificates. This encourages investment in renewable projects and facilitates regulatory compliance. Companies like LO3 Energy [28] and WePower [29] leverage blockchain technology to create innovative solutions for managing and financing renewable energy projects. Blockchain's immense potential in the energy sector is evident in these ongoing projects, and its adoption is expected to accelerate in the coming years.

B. Blockchain use-cases in the energy sector

As part of the work on systematizing of knowledge on the use of blockchain technology for the energy sector, we encountered the problem of the theoretical hypothetical orientation of application scenarios for a given subject area. Thus, in the study conducted by UK energy scientists [18], the wording about possible potential areas of application is mainly used, however, a significant part of the areas of application does not have practical design experience for further use.

However, there are many use cases, which are given examples of real projects in the following, but many of them are exploratory in nature and have not stood the test of time or have not gone beyond the MVP boundaries. Article by J. Wu [15] deals mainly with theoretical aspects of the concept of "Energy Internet", however, there are also examples of real projects, such as "JuiceNet", blockchain platform that allows the owners of charging piles to use JuiceNet to lease the time of charging piles to electric vehicle drivers. As of the time of writing, the company has abandoned the positioning of the platform in terms of blockchain technology, and on the company's website the description of the platform is positioned as "JuiceNet is a patented communication, control, and intelligence platform that dynamically matches drivers' historical charging patterns, real-time input and signals from grid operators and utilities to aggregate and manage charging station demand" [1].

In article by G. van Leeuwen [30], with a high citation index, the theoretical aspects of modelling of an integrated blockchain-based energy management platform that respects physical microgrid constraints are presented. Thus, the key aspect of the classification of blockchain use-case scenarios in the energy sector has become the relevance of using already identified scenarios in a given sample of articles in terms of their maturity and viability when launched in a productive environment. The basis of the article classification logic was identified as Energy Trading Systems, within which can be distinguished 3 key segments of application by target groups and more detailed classification is depicted at Figure 1:

1) Microgrids trading [31], including Consumers to Prosumers trading (P2P)
2) Wholesale energy trading (B2B) [32]
3) Private customer service systems (B2C)

[1]JuiceNet IoT Platform // https://evcharging.enelx.com/products/juicenet-software/juicene

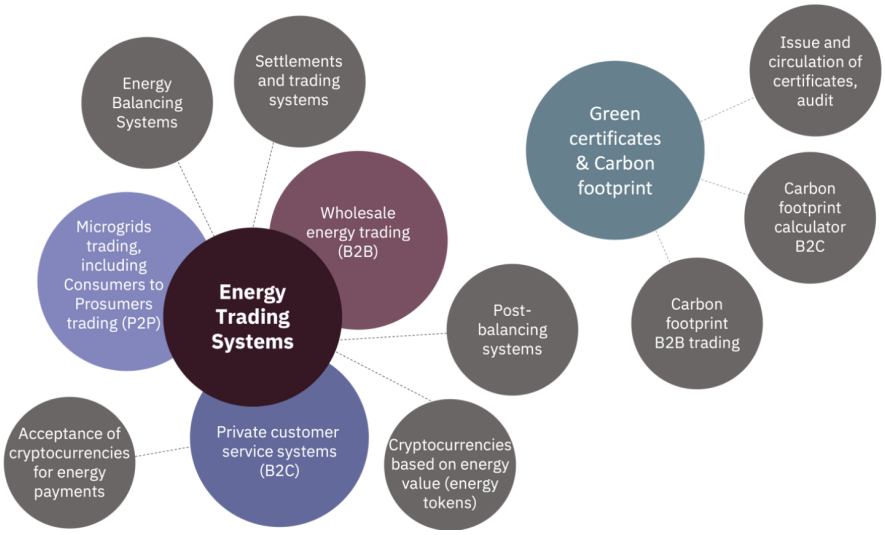

Fig. 1. Classification of blockchain use-cases in energy sector

Within these target segments, the following areas of application for energy trading can be identified:

- Balancing systems (for renewable sources), which represent the redistribution and planning of the load in the powergrid. This includes stimulating production when there is not enough energy, maintaining the load in a given allowable interval, forecasting. potential load and connectivity to the renewable energy grid based on external factors.
- Post-balancing systems, which includes settlement of imbalances with focus on financial transactions to reduce delays caused by lengthy processes of reconciliation, volume actualizations and confirmations.
- Settlements and trading systems for different types of consumption: B2C, B2B, microgrids and P2P. Includes, among other things, mutual settlements between the supplier and the consumer for different interaction models.
- Cryptocurrencies based on energy value (energy tokens). Significant attention is paid to the tokenization of industrial assets based on blockchain technology, including the energy sector.
- Acceptance of cryptocurrencies for energy payments, for example acceptance of Bitcoin as a new form of payment for energy bills. The use of cryptocurrencies to pay for services has recently become more widespread for jurisdictions in which this method of payment is legalized.

However, trading in the energy sector is a key but not the only use case for blockchain technology [33]–[35]. Additionally, an important way to use blockchain technology at the intersection of the energy sector, ecology and sustainable development can be identified as use for green certificates and carbon footprint, including:

- Carbon footprint B2B trading [36], when it comes to trading and resale of emission allowances from one company to another.
- Carbon footprint calculator B2C. Increasingly focusing on responsible consumption and the sustainability agenda, many companies are offering their customers ways to reduce their carbon footprint. For example, a carbon footprint reduction calculator for individual bank customers, when bank offers customer, based on transactions, various ways to compensate carbon footprint.
- Issue and circulation of certificates [37], [38], audit [39]. Certifying authorities responsible for issuing and circulating of green certificates provide this service using blockchain to increase trust and prove immutable data.

C. Blockchain projects and initiatives in the energy sector

In a comprehensive study conducted by Andoni et al. [18], 140 blockchain projects and initiatives in the energy sector were identified. However, since the study, many of these initiatives have ceased operations or been put on hold. Despite this setback, several companies continue to address challenges in the energy sector through the application of blockchain technology.

One such project is the French initiative called Daisee [40]–[42], which focuses on distributing reliable data from infrastructure that can be shared by all stakeholders involved in the energy system. Daisee has conducted field trials at several urban locations [18], demonstrating its potential to overcome financial and institutional barriers to energy transition [42].

Sun Exchange Blockchain [43] is another innovative initiative, targeting the increasing demand for energy in South Africa. By minting energy tokens called ”Sunex,” the project aims to attract investors worldwide through a token-based system, ensuring funds are efficiently used to meet the growing energy needs.

The US Department of Energy (DOE) has also been successful in implementing blockchain technology within the en-

ergy sector since 2017. Their projects include the development of intrinsic ID authentication to improve IoT security [18]. More recently, they have focused on a blockchain-based system to increase grid resilience against cyberattacks [44], [45], aiming to limit damages caused by such attacks or natural failures.

Electrify.Asia, a Singaporean startup, has created a blockchain-based peer-to-peer (P2P) energy trading marketplace, allowing solar panel owners to sell excess energy and providing consumers with better-priced options. After successfully completing an alpha test, the company plans to conduct a beta test with a major Singaporean power generation company.

We have mentioned the most recent updates of blockchain-based initiatives and projects at the energy sector. We would like further to describe more thoroughly such use case as energy tokens.

D. Projects utilizing energy tokens

There were several dozens projects that aimed to bring new values by tokenizing new or existing energy projects. A modern state of the market has significantly changed since the last 2018 market snapshot. There are about ten projects nowadays which utilize blockchain technology making use of tokens for business-related purposes. Major points of a recent review are:

1) Majority of the projects were launched between the 2016-2018, during the "crypto boom"
2) Most of the projects existed only 2-3 years after the launch
3) Projects listed below are working on creating an energy trading platform (p2p), decarbonization, tokenization of electric energy or support of green energy.
4) Limited market only to clean energy
5) Issue with the delivery of the energy as limited with zones
6) Monopoly of the large companies, and need access to Grid to be able to deliver the energy
7) Over 90i% of the projects use Ethereum blockchain
8) Token of the projects have lost at least 75% of their value from all-time high
9) Total market cap of the token in energy sector is about $275-$280 million with the daily trading volume of about $6 million

We have used the following brief evaluation framework:

A. Business model (how they make money)?
B. Is there a unique product of the project? What can be learned and used?
C. Why the project failed, or what is the reason behind the success of the project?

The projects were ranged by token market capitalization.

Web Energy Token. Energy Web Chain is an open-source platform designed to support the development of energy sector applications by building a more traceable, democratized, and decarbonized energy system. The EW Chain aims to provide the digital infrastructure that connects the grid operators, customers, and physical assets. The energy web token is the utility cryptocurrency that powers the blockchain. The token currently has two main uses. It is used to pay gas fees on the network for every transaction and used as a payment source to finance the decentralized applications on the Energy Web blockchain.

A. Income from transactions, token sale.
B. None, token has only utility functions.
C. a) Does not have the trading platform yet for 5 years
   b) Limited themselves only to green energy (solar & wind)

PowerLedger Power Ledger is a platform where businesses and consumers can trade energy peer-to-peer. The platform primarily caters to clean energy that can be produced by individuals and businesses and then shared on an energy grid. Products:

1) xGrid is the key feature of Power Ledger, where entities producing excess energy can sell it on to others.
2) uGrid is a tool for clients in a microgrid/embedded network to enable low cost electricity metering, big data acquisition, rapid microtransactions, and micro grid management.
3) Power Port is similar to uGrid but designed specifically for Electric Vehicle charging stations, allowing cheap and secure electricity metering, settlement, low-cost payment.
4) The Power Ledger platform utilizes a dual token system. There is the publicly traded market token called POWR, and then an ecosystem token called Sparkz.
5) The primary use case of the POWR token is to provide access to application hosts and participants of the Powerledger platform.
6) POWR tokens have other utilities aside from generating Sparkz. The POWR token facilitates access to the platform, provides loyalty rewards to participants, will contribute and connect with charities and organizations, and will provide priority access to Asset Germination Events.
7) Sparkz is generated from POWR tokens, and is solely utilized within the Power Ledger platform. Both buying and selling energy on the platform occurs using the Sparkz currency.

A. Commissions, token sale, carbon certificates.
B. None, utility functionality and medium of exchange to purchase other tokens.
   a) Carbon trading platform (not ready)
   b) Data analysis (collect metering data and analyze the consumption and offers the ways to save on energy bill (not clear how)
   c) Energy trading platform
C. a) Limited number of customers
   b) Limited only to solar and wind energy
   c) No clear regulations (how to tax sold energy)

Efforce. EFFORCE is a blockchain-based energy saving trading platform. The platform brings together those who want to improve the energy efficiency of their buildings or industrial

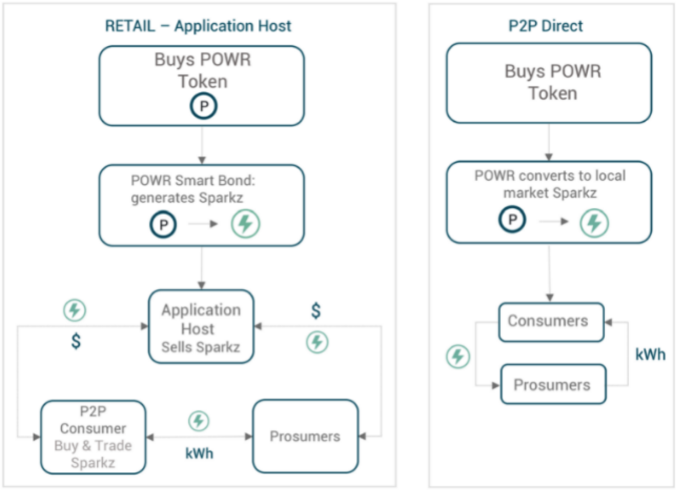

Fig. 2. PowerLedger Architecture

processes with a pool of contributors interested in being repaid in tokens representing the energy savings achieved. How does Efforce work? Consumers initiate the fundraising for a particular energy efficiency project. Contributors would participate with a stable coin into a specific energy efficiency project; their holding of EFFORCE tokens will be used as the criterion to decide the allocation of the contribution proportion of the project). At least 1% of the total energy savings achieved from all the projects will be distributed to all EFFORCE Token holders. Token has three functions; Utility, governance, and value of transfer.

A. Transaction fee, percent from investments
B. Token has mostly utility functions, no unique product yet, only investment pool for energy projects
C. a) The Efforce platform is relatively new, without a long-term viability test;
   b) The contribution process can be complex for the retail investor, increasing the risks of incurring losses while attempting to contribute to a funding pool.
   c) No clear regulations (how to tax sold energy)

Grid+. Grid+ gives consumers direct access to wholesale energy markets, responding intelligently to changes in energy prices. Grid+ created a computer with natively integrated hardware and software for the Ethereum protocol, that pays for a customer's electricity usage in real time. Grid+ operates with two-ERC20 tokens. The BOLT token, required to use the Grid+ platform, is treated as a stable-coin. It's redeemable by customers for $1 worth of energy from the Grid and backed by USD deposits. The GRID token allows Grid+ customers to purchase electricity from Grid+ at wholesale price.

GRID tokens. GRID represents a "fixed amount of wholesale electricity that is accessible to GRID holders at any point in time." So what you are buying in the token sale is a promise that your electricity bill is considerably reduced in the future. Once you redeem 1 GRID for x kWh, 1 GRID is "burned". This redemption function is a function of the total supply, which means: the less GRID tokens are in circulation, the more kWh at wholesale price can be redeemed with one GRID token.

A. Transaction fee, token sale, equipment (provider and service)
B. Token that can be redeemed for the 1USD worth of energy. Access to wholesale market and payment with Grid+ card
C. a) There is no big difference on energy price due to commissions of the platform.
   b) Limited only to US and some states
   c) Need to purchase equipment to be able to access the wholesale market (long return)
   d) Technology is not fully tested yet
   e) Low visibility and limited number of customers (1500 followers)

Electric vehicle zone. The EVZ (Electrical vehicle zone) platform was created to simplify sharing electric vehicle charging infrastructure and address its unavailability. The platform aims to offer charging networking technologies. EVZ claims to be an electric vehicle charge sharing infrastructure platform that automatically connects chargers in idle time and electric vehicle users to provide mutual value and solve energy issues. $EVZ coin is an ERC-20 token operating in the system to pay for the services. Users may receive a limited number of $EVZ as a reward for qualifying purchases and activity on the platform.

A. None
B. None
C. Need large amount of investment to create sharing EV infrastructure; limited market

Sun contract.SunContract is a P2P energy trading platform. The platform intends to be an easy way for producers and consumers to trade in clean electricity by directly using an electricity pool based on smart contracts, a new approach towards peer-to-peer electricity trading. Features:

1) Energy Marketplace
2) Monitor the energy activities
3) Provide consultation about self-sufficiency products.

SunContract (SNC-utility) is the native token of the platform. SNC token is primarily used for trading electricity and energy products on the SunContract ecosystem.

A. Commissions, Token sale, consulting
B. None, only utility token. Planning to create trading platform
C. No trading platform for more than 5 years, limited to the clean energy, no further plans in development of the platform

W Green Pay. W Green Pay (WGP), a project that rewards individual's for Greenhouse Gas (GHG) reduction efforts. WGP is the reward method for the HOOXI app of W-Foundation (nonprofit international organization). HOOXI, Korea's government-backed GHG reduction campaign. HOOXI app will sustain its business by trading its carbon emission units based on the aggregated GHG reduction

data in Korea's KETS (Korea's Emissions Trading Scheme) market. Systemically embedded demand for WGP supports its market liquidity and value.

A. Carbon certificates, commission.
B. Token has only stimulators function (rewards for reduction of carbon emission)
C. Business is based on the trading of Carbon certificates, and limited to Korean market. Low activity and limited information for the user to analyze the project.

Electrify Asia. ELECTRIFY Asia is the retail electricity marketplace in Southeast-Asia addressing the need for transparency and security in the consumption of energy. Electrify planned to build a retail electricity marketplace and later developed a P2P energy trading platform (Synergy) ready for main-grid deployment, with plans to expand across regional markets. Synergy is a peer-to-peer (P2P) energy trading platform that allows for the trading of energy among individual producers of energy. The ELEC token will be used for: consumer loyalty program, transaction fees, and listing deposits for access to Electrify.Asia's ecosystem.

A. Transaction fee, token sale
B. Token has utility functions only
C. Again limited market, issue with the delivery of the product (grid operator have monopoly), launch of trading platform took long time.

WePower. WePower (WPR) is a platform that connects energy producers and suppliers with corporate buyers for easy green energy transactions. The platform serves as an easy way for corporations to access green energy from local producers. The energy suppliers and producers can run their auction on the platform, and energy buyers place bids according to their requirements. On a successful bid, both parties settle on a contract as per the product, price, volume, and term. Smart contracts and tokenized energy help the platform to execute and manage transactions.

WPR token is a utility token that offers access to the energy donation pool constantly filled with 0.9% of energy sold via the auctions. It also serves as a priority access to the energy auctions. The WPR token holders for the 48h of every auction can purchase an energy amount equal or less to the share of all WPR tokens they hold.

A. Energy trading, commissions, donation pool
B. Token has utility function-access to the platform. Product is similar to IDT (contract for the delivery of the energy in the future)
C. Amount of the energy is not enough for the consumption of the large companies, Energy contracts are not available on the auction all the time. Limited themselves to clear energy and corporate buyers and does not have information regarding retail.

Energo. Energo (TSL) is a decentralized autonomous energy (DAE) community based on DApps. System designed to measure and register transactions and settlement of clean energy in local micro-grids. Energo is designed for a new energy production and consumption future that connects producers of varying capacities and energy consumers of diverse needs.

Tesla is the token of the Energo platform. TSL represents its holders' access to power in distributed energy storage equipment. The users need to own TSL to store electricity in energy storage equipment. The network charges a commission amount on the user-stored energy in the distributed storage equipment to ensure the fair use of public resources.

A. Transaction fee, fee for storing energy
B. Token has only the utility functions
C. Project providing the energy storing infrastructure, which is limited due to the fact that infrastructure require large investment. No fact regarding the storage facilities and how it works.

Lition. Lition (LIT) is a cryptocurrency that claims to develop the scalable public-private blockchain with deletable data features developed for commercial products. This protocol keeps data private, compliant with the EU (European Union) data protection policy guidelines, is infinitely scalable, fast, and low-priced. The main objective is to be an easy-to-use and easy-to-develop infrastructure that meets the requirements of all businesses, from small to large companies and developers working on Dapp. Lition tokens issued for transaction execution, staking, and sidechain creation.

A. Transaction fee
B. Token has utility functions
C. No actual product offered since 2019

VI. Conclusion

Projects that we have analyzed are all in early stages, and most of them don't have a product or MVP to offer to the clients. Main issues of the energy token projects are:

1) Monopoly of the large energy companies and for this reason tokenized platforms can only limit themselves to market niches: clean energy and small producers
2) Not enough energy from prosumers that can cover the need of the market
3) Issue with the delivery of the energy as they need to use grids which are owned by large companies
4) Limited with the geography due to the same specifics of the products (usage of grids)

As we have reviewed above, most of the projects lost their value for the reason that they were not able to offer new and unique products to the market. The top 3 projects on the list dominate and cover 82% of the market cap in energy tokens, while one project is about 50% of all the energy token market. Most likely that indicates that the market has a potential to grow, but projects have to offer something unique, products are supposed to be problem-solving and large energy companies are to be engage to become significant for the market..

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