Blockchain Abstract Architecture for Energy Collaboration for Agriculture in Indonesia based on Bibliometric Approach

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Abstract

The direction of development for the application of electric vehicles is starting to be seen with great certainty, this situation is driven by the vision of sustainable development goals (SDGs) where one of them is energy that is minimal from carbon. The agricultural sector is a field of activity that also requires machinery or equipment to support its activities. and currently most of them still use conventional machines that produce quite high carbon, meanwhile, when agricultural machinery is converted to electricity, the challenge is to provide affordable energy at competitive prices and reliable technology. Blockchain is a disruptive technology that has many advantages, especially in terms of flexibility and security to accommodate broad interactions from many parties in an activity chain. The purpose of this research is to develop a blockchain-based architecture to support collaborative energy supply in agriculture that is sourced from renewable energy. we use Scopus indexed data sources to formulate and describe the directions and references of the proposed architecture

Keywords: *Sustainable Development Goals, Energy Supply, Agriculture Machinery, Blockchain*

1. Introduction

Anticipating the need for surges in electricity loads is a trend that will continue to be studied, especially with the promulgation of the Sustainable Development Goals (SDGs) in Indonesia, one of the focuses of which is the provision of sustainable energy with a minimal carbon footprint[1]. The supply of electricity in the future will no longer be monopolized by one company, but all parties can be involved in electricity activities, this is increasingly possible with technology to produce electricity sourced from renewable energy and energy storage which allows several parties or individuals to have electricity that is can be used alone or even traded.
Virtual power plan is the development of a form of energy exchange from various parties who have the capability to produce electricity and energy storage, generally this form of electricity is a micro grid as published by[2][3] using renewable source. Indonesia is a country that has an archipelagic shape with abundant potential for renewable energy resources, building a micro grid system that can support

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electricity supply and have an economic impact on people's welfare is a very noble goal. Development of this form of electricity has been carried out in south Egypt[4], Bangladesh [5], Iran [6]. Advances in the development of information and communication technology have enabled changes in mechanisms and business models for electrical energy, information barriers no longer matter with 5G-based cellular communications and the Internet of Things. And at a more advanced level, electricity modernization can be realized by implementing blockchain as a platform to integrate all participants in the electricity business. With the form of an archipelagic nation that has unique natural resources and community demographics, successful implementation of blockchain requires a holistic study, and in this study we specifically emphasize published literature and then focus on the topic of renewable energy, agriculture and blockchain related to the growth of electric machinery in Indonesia.

2. Methodology

We arrange research steps with a literature approach and group them into the following stages:

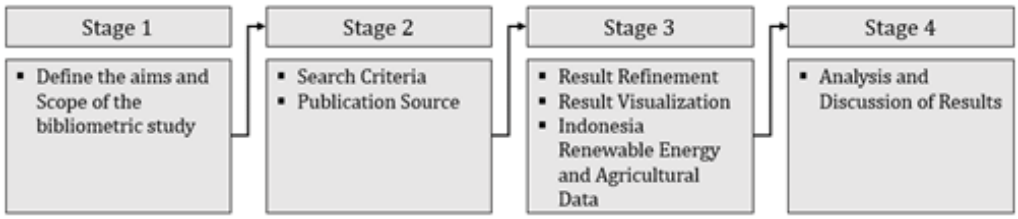

Figure 1. Methodology

Stage 1, is the initial step which contains the determination of the research scope and objectives to be achieved from the results of this study. The purpose of this research is to produce an architectural description for collaboration of energy transactions sourced from renewable energy using the advantages of block chain, the scope of which is the area of application of this architecture is in the field of agriculture towards sustainable development goals (SDGs).
Stage 2, in this stage of determining keywords to search in the publication database, we use the keyword "block chain renewable energy" to get publication results. Then, we use these keywords in two reputable international journals indexed by Scopus, namely Science direct and MDPI.
Stage 3, is an activity to view search results, then sort the relevance of the substance to the research objectives and group the search results based on the categories needed in the research objectives. And after the activity is completed, we visualize the link between block chain and renewable energy in a research correlation network graph, the final goal of this activity is to provide an overview of block chain and its development direction in the energy sector. For agricultural data in Indonesia, we got it from the relevant agency, namely the Ministry of Agriculture of the Republic of Indonesia regarding agricultural machinery and activities in the agricultural sector.

Stage 4, is the final stage which consists of two sub-activities, namely analysis and discussion, at this stage we synthesize the results from published research, and we align these results with data on potential renewable energy and agriculture that we have obtained in the previous stages and discussions regarding the results of the analysis is our contribution in establishing a collaboration mechanism in the block chain system for agricultural sustainability.

3. Research Findings

Based on search results in the Scopus indexed database of international journal publications, using the search keyword "blockchain energy" we get results of a total of 400 publications. Then we carry out refinements by focusing on the scope of energy trading, supply and demand which involves various parties as either energy providers or consumers.

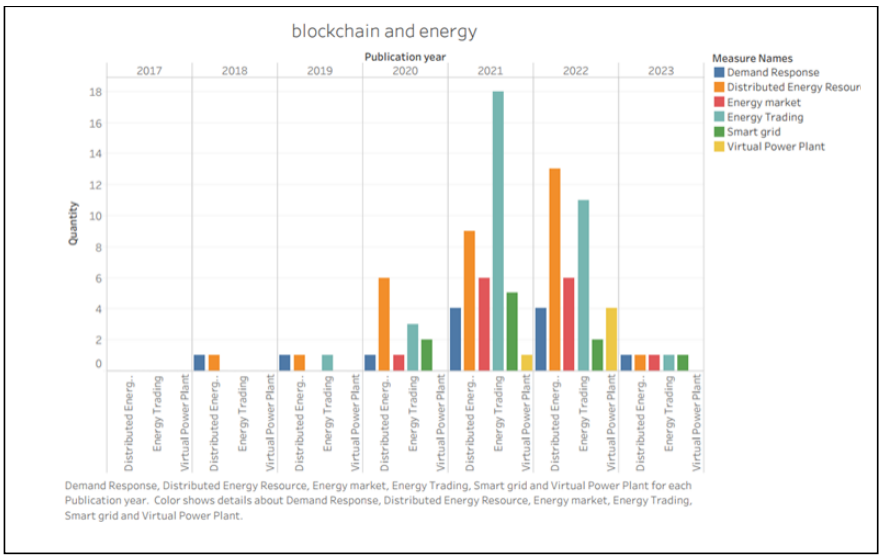

Figure 2. Blockchain Publication Population

Figure 2 shows the population of publications in the energy sector that are closely related to the block chain. as shown in the picture, the scope of energy trading shows more attention in the implementation of meeting electricity needs by implementing block chain as an integrator to create a more efficient and effective system for energy trading.

To get a broad picture of the position of block chain and the relevance of its development to various fractional topics with a focus on the technological to socio-economic areas. And the energy sector is still an interesting discussion and has great opportunities for research, Figure 3 is a visualization of the branch of research focus in block chain.

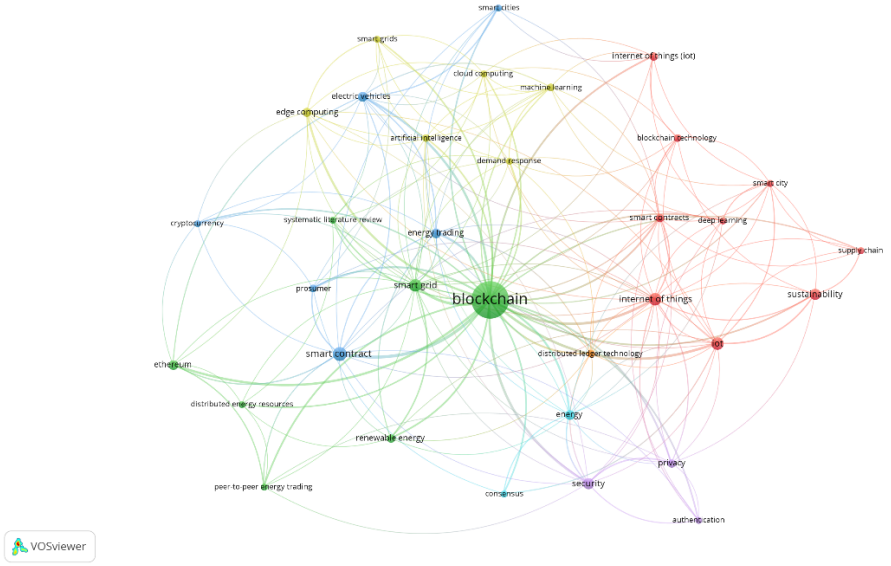

Figure 3. Blockchain research focus

As we stated in the previous paragraph in the methodology section, apart from searching the database with the search keyword "block chain energy", we also explored data on the scope of agriculture and the potential for renewable energy in Indonesia.

Table I below is a search technique that we carried out in Scopus indexed reputable international journals, Google Scholar and Web of Science, we include the search keywords and the results obtained in these searches as follows.

Table 1. Query Result

Keywords	Keywords	Results
Renewable Energy	Journal Article	286
Sustainable Agriculture	Journal Article	200
Blockchain of Energy	Journal Article	315

we select very carefully to get the best search results, the keywords we use yield a lot of information if we only use general words, we use more specific keywords in the search for reputable journals so we get a number of publications in table 1 above.

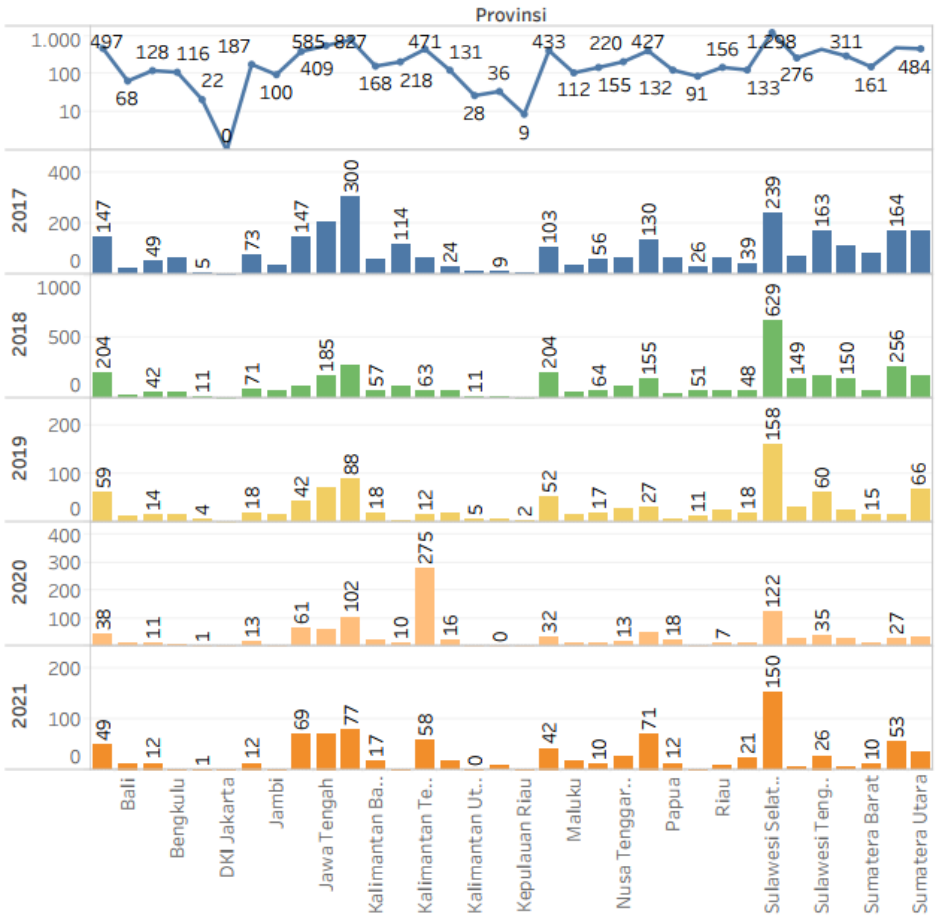

Figure 4. Numbers of Conventional Agriculture machinery in Indonesia

Figure 4 above is a visualization of the number of agricultural vehicle occupations based on the data we got from a census of vehicles or agricultural equipment used in every province in Indonesia, the use of fossil fuel-based agricultural machinery still dominates, especially in the area of the island of Java.

According to agricultural census records from 2017 to 2021 the islands of Java and Sulawesi are the areas that use the most conventional fossil-fueled agricultural tractor engines, this is because these regions have a very large agricultural area compared to other regions in Indonesia. the need for and use of agricultural tools and machinery scattered in every agricultural area is an indicator of the absorption of fossil fuels needed for each agricultural activity or activity, therefore, we will discuss this matter in the energy and agricultural machinery section below.

4. Energy Needs for Agricultural Machinery

Energy is an absolute necessity to drive agricultural tools and machines so that they can function or support activities in the agricultural cycle. The use of fossil fueled agricultural machinery has become a technological trend since the invention of fuel-fired engines. The occupational level of agricultural machinery is still used today due to the availability of sufficient fossil fuels and the reliability of equipment that has been tested in the conditions of the agricultural area itself[7]. agricultural

conditions in Indonesia are not homogeneous, the types of plants, topological differences and economic conditions affect the types of agricultural machinery used[8]–[10], therefore, we group the types of agricultural machinery or implements that are in fact the most frequently used in farming activities in table 2 below.

Table 2. Agricultural Machinery Population

Machine Type	Purposes	Population
Hand Tractor	Plantation	47 %
Walking Rice Trans planter	Rice Field	40 %
Tractor	Plantation and Rice Field	13 %

Justification for the use of fossil fuels for agricultural machinery is carried out using the following formula

Fuel consumption formulation:

$$FC = \frac{v}{t}(ml/dt)$$

At the basic understanding we have to stick on the fuel consumption FC stand for Fuel Consumption and v is the amount of fuel need in an operation for every machine and the last is t as a unit of time of operation.

And to calculate the need for fuel by the area of the operational area, the formula used is as follows:

$$KKa = \frac{A}{T}$$

The above formula is used to calculate the consumption of energy (fossil) where KKa is the actual working capacity and A is the actual total area and T is the total time required to work on the agricultural area being worked on.

Based on these two formulations, calculations can be made regarding the fulfillment of fuel for each agricultural machine with very varied field conditions. In the next stage, we will explain the proposal regarding the blockchain architecture for collaborative energy supply.

5. Blockchain for Energy Supply in Agriculture Machinery

The blockchain technology paradigm is becoming more and more heard in publications, both conferences and journals. Blockchain promises a management system that is flexible, adaptive and safe to be implemented in an environment that contains multiple users, stakeholders and business people.

the implementation of blockchain in the energy sector provides great opportunities, especially in the distribution of energy through a pre-existing grid system, there are two important things to pay attention to in the implementation goal, namely technical social factors, politics and energy consumption itself [11], a deeper discussion of the blockchain concept in energy trading related to Peer to Peer[12], electric vehicles[13], energy storage[14] must be emphasized in the context and

policies in force in the country that will implement it [15], and a proposed idea regarding buying and selling energy in smart energy using a blockchain called prosumer SG 2.0 with the concept of decentralized system intelligence that is adapted to certain conditions [16].
the future of electricity trading will clearly lead to a virtual power plant architecture in which energy generation[17], energy storage and consumers will be more diverse[18], based on the literature we mentioned above the conceptual design of blockchain and energy inflammation leading to the active participation of all parties is described in Figure 5 below.

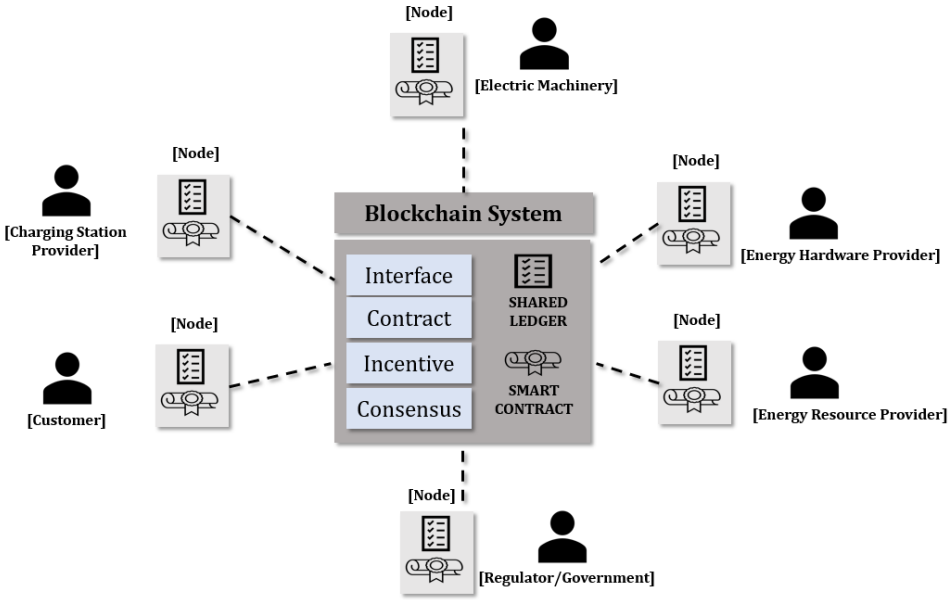

Figure 5. Blockchain Concept for Energy Trade

Fundamentally, we refer to the established blockchain architecture, namely the existence of smart contracts and shared ledgers which are the main core in addressing accountability in this system. However, what makes this concept different is the components of the parties involved in participating in supply and demand activities as follows.

5.1 Participant

we define six participants that are accommodated by the system namely (1) the government, functions as a policy controller in the energy trade (2) energy source provider, functions as a party responsible for the availability of new or renewable energy resources (3) energy hardware provider, functions as an infrastructure provider related to energy buying and selling facilities (4) electrical machinery, what is meant here is a provider of electricity-based brands or agricultural machinery, the current conditions in Indonesia are still very limited or even said to be very minimal (5) charging station providers , functions as a party that interacts directly with consumers who use electricity and (6) is a consumer where the future of the energy trading system must be able to win the market with all the improvisations in the future.

5.2 Blockchain system

The blockchain building that we propose contains several important parts, namely (1) interface, interface design is one part that can be considered quite challenging, interface issues contain more user perceptions which focus more on ease of use of the system from a consumer perspective, but from a programming perspective could be more directed towards a stable and complete API (2) contracts, like blockchain features basically, contracts are a systematic arrangement of agreements by parties who want to be involved in the blockchain system, which makes it interesting to deepen is, in the context of energy trading in in the agricultural sector and in countries with abundant natural resources and the character of a pluralistic society, contracts must be made differently without the risk of injustice (3) incentives, the purpose of implementing incentives is to invite active participation for all parties in keeping ledgers recorded safely, the problem of incentives is very closely related to how money can be obtained from the activity of digging up transaction data (4) consensus is related to maintaining data accuracy including transaction verification and validation.

The concept of collaboration that we carry out in this study emphasizes the direction of active participation from all elements of society in an area with a variety of islands, topologies and varied new renewable energy resources. In the context of fulfilling energy for electricity-based machines in agriculture or plantations, it is possible that some areas have advantages and disadvantages of certain natural resources, therefore, collaboration can be carried out across regions, and providers of infrastructure or energy hardware have generally been carried out by national electricity supply companies.

6. Conclusion

Indonesia is an agricultural country that relies on natural products, especially from the agricultural and plantation sectors, with a large agricultural area, the use of fossil fuel-based agricultural machinery is a major concern that has not been touched.
This research is an initial initiative carried out to explore the current situation related to conventional agricultural machinery and the level of demand for these machines with the type of agriculture and the size of the area.
The collaborative concept aims to support fairness in energy trading, where communities, governments and other parties can be involved without monopoly. Blockchain is a technology that promises scalability and accountability that can support the concept.

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