

Decentralizing the Energy Sector using Web3.0

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Abstract

The energy sector plays a major role in controlling the current climate change crisis which is a major issue for the human race and nature. It is a well-accepted fact that Energy is at the heart of the climate change. To stop the climate change issue becoming too noxious for nature, it is important to decentralize the energy sector and to make use of the advanced technologies such as Artificial Intelligence, Blockchain and Internet of things. This paper discusses the current trend in usage of energy sector and how it can be decentralized to achieve the SDG Goal No. 7 in near future. The paper also analyses the Electricity Act, 2003 and what are the amendments that can be done in the act to resist the climate change. As Renewable energy [RE] plays a major role in mitigating the climate and energy crisis, the paper analyses the present amount of RE and also recommends steps to make the public to generate and use Renewable Energy. This paper analyses the global legislations regarding the RE and also how it can be improved and also about the Energy trades.

Keywords: Decentralization, renewable energy, artificial intelligence, energy trading, blockchain.

INTRODUCTION

The progression of history can be understood as the pursuit of managing larger reservoirs and the movement of increasingly potent and adaptable energy sources, while finding more economical methods to transform them into heat, light, and movement with improved efficiency and reduced expenses [1]. The energy sector has played a vast role in developing the civilization and improving the lifestyle of humans and environment. But the answer for the question “whether the full potential of it have reached everyone in the society” is negative. To make every people in the society to have a fair access to the benefits of energy sector, decentralization of this sector is a solution. The advent of technologies like Artificial Intelligence and machine learning, which fall within the realm of web 3.0, makes achieving this even more straightforward. At the same time the legal blockades has to be resolved to have a smooth transformation.

Web 3.0

The phrase "web 3" was introduced by Gavin Wood, one of the founders of Polkadot and a co-founder of Ethereum, in the year 2014 [2]. Web 1 indicates the internet era from 1989 to 2004. Web 2.0 revolved

around the idea of using the web as a platform. Web 3.0 or web 3 refers to the next generation of internet which is preferably decentralized and underpinned by various technologies like Internet of Things, machine learning, Artificial Intelligence and distributed Ledger technologies which allow simultaneous access, validations, and record updating across a networked database. Many technologists view web 3 as a potential remedy for concerns regarding the excessive centralization of the internet. They have expressed the idea that web3 could improve data security, scalability, and importantly privacy.

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Issues In Centralized Systems

Centralized generation system refers to the method of producing electricity on a large scale in central facilities situated at a distance from end consumers, and then delivering the electrical power through a network of high-voltage transmission lines to serve multiple end users via the electric power grid. One of the major drawbacks of this system is this facility uses non renewable resources such as fossil fuel power plants, nuclear power plants etc., which have a negative impact on environment and speeds the process of climate change. another drawback is that there is a large energy gap between the end users due to many factors such as price of energy which can't be afforded by many people. It has been estimated that around 1.03 billion people around the world do not have access to electricity and a comparable number of people lacks access to modern, safe, sustainable, affordable and regular electricity supply [3]. In 2020, 87 percentage of Global electricity is based on thermal, nuclear and hydroelectric power plants which are directly dependent on water availability [4]. Centralized energy systems not only affects environment but also they are under very dangerous position due to climate change. To illustrate, nuclear power plants situated in low-lying coastal regions may face susceptibility to rising sea levels and flooding linked to weather conditions. These concerns can be reduced by employing decentralized energy systems.

Decentralized System

A decentralized energy system is established by siting energy production facilities in proximity to the point of energy consumption. This approach facilitates a more efficient utilization of renewable energy sources, leading to decreased reliance on fossil fuels and enhancing ecological efficiency. One of the advantages of using the decentralized system is that it puts power sources close to the end users spreading across a region which reduces the transmission and distribution inefficiencies and also economic and environmental costs. The decentralized system hinges on three primary elements: distributed generation, energy storage, and demand response. The system's structure can either be linked to the grid or exclusively cater to a specific location, without channeling any surplus energy into the grid. By using Web 3 the efficiency of this decentralized energy system can be improved.

Efficiency

With the enormous data produced by smart devices which are connected to internet, a Machine to Machine communication will create new forms of activity. Web 3 will enable products or devices to establish connections and share data through decentralized identifiers. These identifiers will enable grid operators and energy companies to authenticate customers engaged in the energy market. Once end-users are verified, energy services can be tailored to households, businesses which potentially reduce cost and results in better demand forecasting. This method can be applied to electric vehicles and intelligent appliances to achieve cost savings by utilizing energy during non-peak hours and effectively incorporating renewable energy resources. An alert algorithm can be created to inform users and devices when the power grid encounters a crucial requirement for energy conservation, enabling the system to readjust accordingly.

Transparency

One of the major challenges faced by energy industry is the lack of transparency. One of the prime examples is the concept of carbon offsetting. Carbon offsets are a “credit for negating or diminishing the impact of emitting a ton of carbon dioxide by paying someone else to absorb or avoid the release of a ton of CO₂ elsewhere”. In a recent report it was stated that the Voluntary carbon markets will be more about \$50 billion by 2030 [5]. Even though the carbon offsetting may be best model to mitigate the climate change crisis but it has some procedural disadvantages. It is mainly because the voluntary carbon offsetting market operates under different procedures and standards. In the market, there is a lack of widespread consensus or agreement regarding assurance, and it largely operates on a case-by-case basis. These problems can be addressed through the application of web3 technologies like Distributed Ledger Technology and the Internet of Things, which can expedite the establishment of standards and accountability by continuously measuring and overseeing environmental data. By making

use of Iot, the connected devices across a company's value chain share the ecological impact data and will be used in executing smart contracts based on precise emission calculations. The comprehensive regulatory structures that ensure the transparency and the integrity of the carbon market can be enhanced with the help of web3. It also helps to give a fair play in the market by helping the small market players to overcome barriers to entry and makes them to trade cost effective credits.

Automation

Operators need greater flexibility and improved grid management when more devices connect to the grid. This can be achieved by using Web 3.0 which will acts as powerful tool to enable them interact and also manage distributed assets across the grid automatically. Smart contracts are code written into a block chain that executes the terms of an agreement or contract from outside the chain [6]. It automates the actions that would otherwise be completed by the parties in the agreement, which removes the need for both parties to trust each other [7]. Web3 has the potential to facilitate the automatic execution of smart contracts between energy producers and consumers, eliminating the need for human involvement. Additionally, it can assist energy producers in reducing costs by automating their backend operations. As there is no intermediates present in this type of contract, the process of transaction recording and settlement can be done instantly with minimal reconciliation effort.

Democratization

One of the main ideas of web3 is the minimizing the role of central authorities. Instead of Central authorities, the system will have decentralized autonomous organizations which provide governance frameworks.

Energy Trading

Energy trading involves the practice of purchasing and selling energy to capitalize on the variations in the energy market. This concept of energy trading can be elucidated through the system proposed by N.Z. Aitzhan [8]. They proposed a blockchain-based energy trading platform where the energy producer and consumer can negotiate the energy price. Then the energy is transferred to an asset and its ownership is traded in Bitcoin. To protect against malicious energy producers that may attempt to sell a given block of energy to multiple consumers, the energy company keeps track of traded assets and verifies if an asset is being traded. This type of trading system provides a 100 percent transparent system and also matches power buyers and sellers who are in need of it.

Renewable Energy for Energy access

Renewable energy technologies generate many environmental and economic benefits. Investments in these technologies will bring the added benefit of stipulating employment and also economic growth which results in moving the world much closer to a low carbon economy. Distributed Renewable Energy Access (DREA) systems, comprising both standalone and off-grid systems, will autonomously generate and distribute energy without reliance on a centralized electrical grid. As per report, DREA systems represent around 6 percentage of new electricity connection worldwide between 2012 and 2016, mainly in rural areas. DREA systems can offer essential services like lighting and cooking to off-grid communities. In sparsely populated rural regions, DREA systems will be the swiftest and most economical means of delivering electricity. There are many legal hurdles in spite of technical hurdles for decentralizing the energy sector so the legal framework and energy governance will be discussed below.

Energy Laws

The importance of regulating energy was given importance in the late 90's. Many International and National Instruments were enacted to minimize the negative impacts caused by energy generation such as climate change, carbon emissions. International frameworks consists of the Brund land commission report, commission of sustainable development and the Energy charter trust.

Electricity Act

In India, the legal structure that regulates the electricity sector is the Electricity Act of 2003. This legislation sets up electricity regulatory commissions at both the central and state levels, and it allows for appeals to be made to the Appellate Tribunal for Electricity (APTEL), with further recourse to the Supreme Court of India. Though the renewable energy plays a vital role, but the electricity act does not provide a definition for Renewable energy. You can locate the definition within the 2020 regulations issued by the Central Electricity Regulatory Commission, specifically under the section titled "Terms and Conditions for Determining Tariffs from Renewable Energy Sources." It defines "renewable energy" as electricity generated from renewable energy sources.

Energy Conservation Act

The energy conservation act was enacted in 2001 to provide an efficient use and conservation of energy and also for the matters connected therewith or incidental. A notable aspect of the legislation is the creation of the Bureau of Energy Efficiency. The bureau's core objective is to aid in the formulation of policies and strategies that prioritize self-regulation and market-oriented principles. As per the Bureau's recent report India's electricity consumption in 2019-2020 was around 1.2 million GWh, which increased by a margin of 6.74 percentage from 2010 to 2011 [9]. The bureau in its latest report states various methods for electrification such as Prioritizing energy efficiency in industrial processes, Direct electrification of industrial processes wherever possible and Renewable, hydrogen based and power to X based industrial processes. It also obliges the state agencies for identifying the focus areas for green hydrogen applications through the recently announced National Hydrogen Energy Mission [10]. In 2022, the energy Conservation (amendment) bill was introduced in Lok Sabha. The upcoming bill grants the federal government the authority to define a carbon credit exchange program. Additionally, it allows for the possibility of mandating designated consumers to fulfill a specific portion of their energy consumption from non-fossil fuel sources. It also provides for composition of the Bureau of Energy Efficiency and introduction of standards to vehicles and vessels. This type of measures can help India to decentralize the energy sector better than now.

India's Energy Governance

As per the Indian constitution, the petroleum, natural gas, aviation and railways sectors come under the Union list of Seventh schedule, whereas electricity comes under the concurrent list. Consequently, the energy sector is subject to the jurisdiction of numerous ministries and agencies at both the central and state levels. Within the scope of the Union government, various ministries and agencies hold responsibilities related to energy matters, all falling under the overarching oversight of the Prime Minister's office. NITI Aayog and Department of Atomic Energy play a vital role in Energy governance.

The ministries which come under PMO's offices are as follows:

- Ministry of Power
- Ministry of New and renewable energy
- Ministry of Petroleum and Gas
- Ministry of Coal

Agencies which are responsible for energy governance are

- Central electricity Regulatory commission
- National institute of solar energy
- National institute of wind energy
- Indian Renewable energy development agency
- Directorate general of Hydrocarbons
- Petroleum and natural gas regulatory board
- Petroleum planning and analysis cell
- Coal controller organization

Public sector undertakings which are publicly owned companies also have a role in India's energy governance. Some of them are as follows:

- Power system operation corporation
- Power finance corporation
- REC
- NTPC
- POWERGRID
- Energy efficiency services ltd
- Southern Electric comp-any
- Oil and natural gas corporation
- Indian oil corporation
- Coal India ltd

Legal Measures

It is essential to conduct an examination of the legal framework that oversees energy efficiency, including policies, regulations, institutions, and organizational structures. There is no overarching energy efficiency policy. The draft Renewable energy act 2015 has given many better measures to address the energy sector. The act has to be enforced so that the many people and environment will get benefit from it.

CONCLUSION

Sustainable Development Goal 7 strives to "Guarantee access to affordable, dependable, sustainable, and contemporary energy for everyone." It is widely recognized that access to energy is a crucial cornerstone for both the welfare of individuals and the environment. Hence necessary steps must be taken for a better future.

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