


Chapter 56

Blockchain Technology in Solar Energy

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ABSTRACT

Two of the important topics concerning scientists and governments are blockchain and climate change. After the paper of Satoshi Nakamoto, blockchains became a global phenomenon. After its usage for cryptocurrencies, blockchain is starting to be used for digital protocols and smart contracts. Blockchain technology is used in many sectors, such as banking, finance, car leasing, entertainment, energy, etc. Climate change leads to global warming, which means the long-term warming of the planet. Therefore, governments have made an effort to decrease global warming or keep it stable. One of the mitigation ways of global warming is to use renewable energy. Solar energy is one of the most used types of renewable energy sources, and also blockchain technology is widely used in this sector. In this chapter, the authors investigate the use of blockchain technology in the solar energy sector.

INTRODUCTION

Blockchain provides peer-to-peer transaction platforms that use decentralized storage to record all transaction data. Blockchain applications are used in different industries. These industries are digital securities trading industry, digital identity industry, proof of ownership industry, peer-to-peer transactions industry, network infrastructure industry, etc. Based on their stage of development Blockchain applications can be divided into three broad categories namely: “Blockchain 1.0”, “Blockchain 2.0”, “Blockchain 3.0”. The first category comprises cryptocurrencies, the second category represents a digital protocol, and the last category is the stage where the smart contract concept is developed.

DOI: 10.4018/978-1-7998-5351-0.ch056

Solar energy is one of the renewable energy sources which is essential for sustainable human life and fight against climate change. Solar energy is widely used green energy type which can intelligently integrate the actions of all connected users thus they can both produce and consume electricity using smart-grid technologies. The users, which both produce and consume electricity are called as a “prosumers” Smart-Grid system has some advantages such as improve the robustness of grid, self-healing capability of grid and internality of the grid. Also, a smart-grid system has some characteristics such as; reliability, security, efficiency, deployment and integration of distributed resources, generation demand response and demand-side resources, advanced electricity storage and peak-shaving technologies, etc. Because the countries mitigate environmental degradation; they start to use Smart Grid.

Smart grid systems have different technologies, but mostly centralized technologies have been used in the sector. Blockchain is better than non-decentralized technologies owing to transparent transactions and no single user controls. Compared with traditional methods; using decentralized technology, the distance between generation sites and load centers are decreasing. Moreover decentralized public ledger is a barrier of vulnerabilities of a central store of data. For the solar energy prosumers; it provides a safe and easy way to exchange their energy production.

One of the Blockchain project in smart grid is provided by Belgian Enervalis company and Dutch Eemnes Energie company. Also, there are some projects in UK and USA which use Blockchain technology. For example, LO3 Energy, a young New York company, is working in the Brooklyn Microgrid project. In UK Centrica company aim to make a local energy market using Blockchain technology,

The contributions of the chapter to the book are providing knowledge of Blockchain technology and Blockchain usage in solar energy production. We do not aim to provide information about the logic of the blockchain but aim to focus on blockchain in solar energy production. The first section is an introduction, in the second section fundamentals of smart grid and solar energy are discussed generally. In the third section, the chapter will be focused on blockchain applications in solar energy production smart-grid systems. In the last section of the chapter, the chapter will be summarized.

SMART GRID IN SOLAR ENERGY

Solar Energy

Solar energy is one of the types of renewable energy sources. Non-renewable energy sources are finite, dependent, the emitter of greenhouse gasses and more expensive than renewable energy sources because of these reasons renewable energy is essential for sustainable human life. In recent years renewable power capacity of the world has been increased, and the most used renewable energies are solar PV, wind power and hydropower. According to the International Renewable Energy Agency, IRENA (2018) the costs of renewable energy have declined therefore the capacity of the renewables has been increased, by 2017. Cumulative global investment in the sector totaled USD 2.9 trillion since 2004.

Perez and Perez (2009) present the planetary energy reserves for both renewables and non-renewables. Figure 1 presents the known reserves; in the figure yearly potential energy is given for renewables because they are not finite, known reserves are given for the fossil and nuclear resources because they are finite.

It can be understood from Figure 1, the difference of the potential of solar energy from other renewable and non-renewable sources' potential is very high.

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