ISSN: 2639-7455

Short communication

Earth & Environmental Science Research & Reviews

Commentary on the Emerging Energy Blockchain Technology

Zhihao Li[1], Jiapeng Su[1], Anjun Jin[1]

[1]The Maritime Faculty, Ningbo University, Ningbo, Zhejiang Province 315000

[*]Corresponding author
AnjunJin, The Maritime Faculty, Ningbo University, Ningbo, Zhejiang Province 315000.

Submitted: 01 June 2020; **Accepted:** 08 June 2020; **Published:** 02 July 2020

Abstract

This article promotes the emerging technology application of the energy blockchain (EBC) innovation and the published energy source (PES). The prosumer, for the most part, expends energy of its own and utilizes an incorporated energy framework that occasionally produces energy for other customers. A complimentary multi-energy sources can improve various quality and increase the merit of the application of renewable energies. For example, an underlining case for the ocean thermal energy conversion (OTEC) is investigated. Firstly, the restriction on a traditional OTEC is ordinarily at about 3% that can be overcome with an improved efficiency which is at 6% to 12% as shown in this study. Second, the contextual investigation should shed light on the demonstration and system produced for EBC. Third, a precise investigation uses the EBC input parameters as follows: OTEC multi-energy complementarity, energy storage/ power parameter, and the smart grid power. A complimentary multi-energy sources can improve various quality, increase the merit of the application of renewable energies. The author constructs a mathematical model to study the maximal available benefit for a prosumer. This model connects the electric load to the external grid power through a gate-control that has a smart meter inside the prosumer's EBC framework. All the above parameters usually depend on time variables. Finally, this study is to present EBC properties in the view of a PES value dependency law. Output and its optimization is to resolve the dependency law upon input parameters referenced at above. The optimum solution increases the benefit for the prosumer.

Keywords: Energy Blockchain, Published Energy Source, Renewable Energy, Energy Storage, Ocean Thermal Energy Conversion, Peer to Peer

Introduction

The modern world is weary of one-off energy resources; the ascent of various renewable energies, the fast advancement of communication innovation and the aggravation of climate change are for the most part very complex or polymorphic circumstances. These circumstances exhibit challenges to confront the future of humankind. The utilization of new advances to resolve energy deficiencies, to mitigate climate abnormalities and to reduce potential pandemic environment has been the quest for many scientists. Many exciting technological advancements in the published energy source can be very valuable due to that the technology can readily benefit the users with significantly innovative solutions.

First off, because of the dual necessities of climate change and ecological protection, the traditional energy structure ruled by fossil-based energy, for example, coal, oil, and gas is steadily being questioned due to their poor consequential carbon emission. This traditional structure of energy is expanded and/or replaced to include the alternative energies; for example, the solar photovoltaic and wind powers. The projection of available energy resources is illustrated in (Fig. 1):

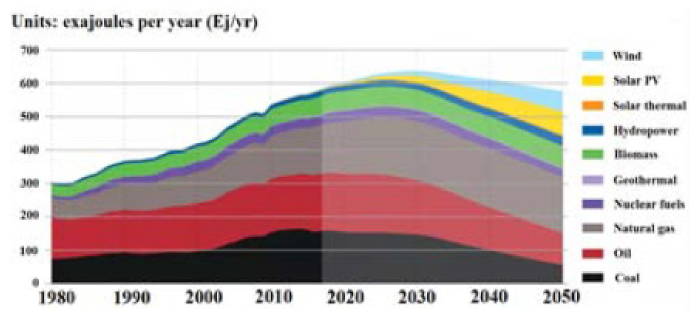

Figure 1: The illustration shows the yearly trends of every known energy supplies.

The new energy structure depends on a new power framework. The new power framework has characteristic points of demand that are has more under digitalization than its counterparts with fossil energy in nature. Moreover, there is quick development and emphasis of artificial intelligence, big information, cloud computing, the Internet of things and various other advances. This delivers a computing infrastructure for the digitalization of traditional industries and gives equitably address of the specialized issue for the ascent of digitalization.

Commentaries

Blockchain innovation started from an establishing paper "Bitcoin: a peer-to-peer electronic money framework" published in 2008 by scientists under the pseudonym Satoshi Nakamoto [1] in 2009, the bitcoin transaction framework was formally conceived, and blockchain innovation progressively entered the public eye. With the surge of demand for bitcoin in 2016 and the quick development of demand for bitcoin, the investigation on the original blockchain innovation has quickly expanded. Its applications have stretched out from the original digital money to finance, the Internet of things, smart manufacturing, etc.

A white paper by the Ministry of IIT, China, includes the key innovations context of the blockchain technology. Based on the literature [2], blockchain innovation is another decentralized infrastructure and published processing paradigm that utilizes cryptographic blockchain structure to check and store information, that utilizes published node contract algorithm to generate and update information, and that utilizes robotized script code (smart contract) to program and control information.

The PES approach is tremendously useful that governs a prosumer's value dependency law and that is worked out with an application at below. Specific input parameters include the following: the rate of power generation (PG) such as OTEC and multi-energy complementarity, local consumption of Energy (CE); and the feed-in of grid power (GP). Moreover, the energy storage is included in the application. Among several output variables, the one solution to seek for is the financial saving and earning (SE), the benefits of energy ES, and peer-to-peer transaction. (Fig.2) shows a schematic of the energy blockchain.

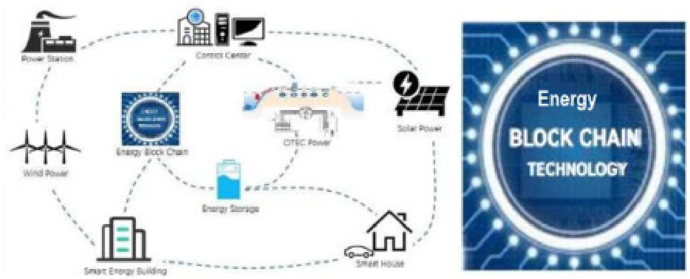

Figure 2: The energy blockchain architecture is depicted to likely drive toward a globally sustainable future of energies.

The input parameters are measured data and has time variance. These parameters are monitored daily and have weighted average to influence the output. The output variables, e.g., Fin, deliver results that the prosumers can make decisions based on the data from the input parameters.

$$Fin(t)=\int dt\{[PG\times\alpha_1(t)-CP\times\alpha_2(t)]\times p(t)+ES\times\alpha_3(t)\times\Delta p-GP\times\alpha_4(t)\times p(t)\} \quad (1).$$

Various input parameters are the measured data that have time dependency, and that is integrated over the time as shown in eq.(1).

The PG is an input parameter, e.g., of the total solar PV generation (from specification); with α1 being an ambient power coefficient that has a range of [0, 1] and varies with time during the day. P (t) is the price from utility provider.

CP is an input parameter dictated by a prosumer who decide how many in total household power and/or what electronic devices to use for what time in which day. In the eq.(1), the term CP is multiplied by α2 where 2 is a parameter that r of the distributed power deployment that ranges [0, 1], or that may be a customer's specification.

Normally the ES stores energy at the night and discharges in the day. The energy level of ES ranges by the manufacturer's spec, e.g., between 10% to 95% during a discharge-charge cycle.The coefficient α3 in ES is effective charge-discharge rated coefficient that ranges [-1, 1]. Its actual range may depend on the manufacturer's specification.

GP represents the grid power input that is a parameter for prosumer to decide. In the equation, the term GP is as α4 * GP, max; where α4 is an ambient power coefficient that ranges from 0 to 1. A smart meter connects EBC to the external grid.

There are separate studies that have previously found that the photovoltaic capacity is 1.3 times of the peak power of the family, and the energy storage capacity is 2.3 times of the peak power of the family.

A typical hardware structure delivers the important inputs parameters of the system. Inside a local access network (LAN) in particular, the Energy LAN framework, the power supply side can be made of wind turbine, solar photovoltaic (PV) unit, OTEC, energy storage framework and the external power matrix. The power demand side is made of the traditional load, power transaction, and published available energy storage. Under the activity of the automated demand reaction mode, the demand-side energy storage coordinates its various variables and operation algorithm. (as a control-object). Under the condition that the inventory of renewable energy is equal to or higher than the traditional load demand, the energy storage framework may decide and react to the framework by charging or discharge the ES.

As indicated by its charge condition, the energy storage framework can alter its charging and discharging mode to compensate the change in renewable energy output, to load demand and electricity transaction cost, to improve the use effectiveness of renewable energy and load levelling of the grid. Under the condition of obtaining power from the power grid; the published capacity of PES is dependent upon the present energy storage condition. Power control system (PCS, or power management unit) is a bidirectional energy transference mechanism that causes energy transaction between the energy storage framework and the power grid. It is equipped with all universal communication interface that acknowledges charge and discharge mode switching, and power control function by accepting the control strategy issued by an upstream controller. Moreover, it can execute digital command by a battery management system in the downstream. Smart electric meters acknowledge two-way metering, recording both energy storage consumption and power output.

The energy storage is designed with its end goal that provides stable power. On account of multi-energy generation, the accessible power adjustment at peak and valley could benefit the prosumer and earn the price differential; the energy storage unit is significant for both energy use and levelling load. Authors have indicated that the OTEC-based PES/energy blockchain (EBC) innovation can accomplish an objective that meets smart and stable power output, transparent, secure, and self-repairment features.

Let us work on e a design recommendation, authors have investigated a multi-energy complementary system and at a mega-watt level for output. Governed by a value dependency law, a typical solution is shown at Table-1 at below.

Table-1: Illustration of a multi-energy complementary system

PV (kW)	WP (kW)	OTEC (kW)	CP (kW)	ES (kWh)
200	400	800	2400	3000
400	600	1000	2400	1500
600	800	1200	2400	300

Conclusions

Within a new digitization framework, a central intelligent processor, aka, a power management unit, issues command information. The prosumer operates his/her energy block chain (EBC) system to deliver ROI with optimal (maximum) benefit. The EBC digitization is technologically advantageous for the value adding and peer-to-peer transaction with the alternative energies. The multi-energy complementarity is employed to balance the energy and overall availability. OTEC provides the base electricity and stabilizes the base power; OTEC has net power output and has achieved significantly improved efficiency. Along with the energy storage, detailed studies of published energy source (PES) provide the prosumer a value dependency law that can derive maximal value and maximum efficiency. The authors discover the PES law for maximal ROI that can deliver best value addition and stable power.

References

1. Nakamoto S (2019) Bitcoin: A peer-to-peer electronic cash system 1-9.
2. Yong Y, Feiyue W(2016) Blockchain: the state of the art and future trends. Acta Automatica Sinica 42: 481-494.