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# Establishing a Secure, Transparent, and Autonomous *Blockchain of Custody* for Renewable Energy Credits and Carbon Credits

Michael J. Ashley and Mark S. Johnson

**Keywords:** Auditing, costs of IS/ITT, data envelopment analysis, economic evaluation of ITT, entrepreneurship, information and telecommunication technologies (ITT), integration of ITT into the organization, integrating technology strategy into business strategy, management of innovation, new product development process, supply chain integration, transaction costs

## Abstract

To facilitate the widespread adoption of clean energy, we must devise practical economic incentives to deploy clean energy assets while reducing barriers to access that clean energy. While renewable energy credits and carbon offset credits successfully push these goals forward, the associated accounting and management systems still suffer from numerous flaws that drive costs up and slow the monetization of clean energy assets. Blockchain technology has emerged as a promising solution that can provide a secure and transparent distributed ledger, while autonomously executing transactions upon fulfillment of pre-defined criteria ("smart contracts"). As a result, credits can be easily tracked from generation through ownership trades to ultimate redemption. This leaves a simple audit trail, significantly reducing the associated time and cost, and enables producers to monetize their credits immediately after generation. Clean Energy Blockchain Network (CEBN) has recently announced a partnership with the Silicon Valley Power, where we will apply blockchain technology to simplify their participation in the Low Carbon Fuel Standard (LCFS) program. This real-world deployment will demonstrate how blockchain technology can dramatically simplify extremely complex trading environments and enable the practical implementation of valuable programs such as LCFS that financially incentivize clean energy production and use.

## Introduction and Discussion

Key goals in the renewables industry have sought to increase financial incentives for developers to execute new clean energy projects and to reduce economic and logistic barriers preventing end users from accessing clean energy. Renewable energy credits (RECs), which represent one megawatt-hour (MWh) of clean energy fed into the grid, and carbon credits, which represent one metric ton of avoided $CO_2$-equivalent emissions, remain valuable tools to assist with both of these goals.

End users of electricity can purchase and redeem RECs to claim responsibility and receive credit for clean energy usage. These transactions are typically completed by large entities such as universities and corporations. RECs provide clean energy asset owners with additional revenue streams, in addition to sales of physical energy generated. Similarly, carbon offset credits can be purchased from low carbon emitters or environmental project developers, such as in planting new forestry, such that entities can claim responsibility and receive credit for fewer carbon emissions.

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While they have successfully incentivized clean energy and environmental projects, RECs and carbon credit systems still suffer from inefficient accounting and management procedures. Credits are monitored manually, with credit generation and ownership transfers often recorded on Excel spreadsheets and PDFs. Typically, they are reconciled quarterly (when data is submitted) and credits are awarded months later. These activities require costly and time-consuming auditing, and still suffer from "double counting" issues, which can seriously jeopardize the integrity and incentives of the system.

Ideally, REC and carbon credit system processes would be efficiently supported by three characteristics: 1) a digital representation of a credit would be created autonomously in near-real time when the requisite conditions are met – for example, a 1 MWh clean energy production certification – and stored in the owner’s “account”; 2) digital credits would be quickly and frictionlessly traded on a secure network; and 3) credit generation, ownership transfer, and redemption would be executed, verified, and recorded on a transparent and searchable ledger for simple audits.

Such a system would reduce the time and cost associated with trading, redeeming and auditing credits. This system will allow credit purchasers to pay less and enable producers to collect more revenue, monetizing their assets faster.

Blockchain technology has emerged as a promising solution to alleviate the issues associated with conventional credit management systems. Blockchain describes a distributed digital ledger technology in which transactions are recorded on numerous computers connected to the network, such that attempts to tamper with historical data would be quickly flagged as incorrect.

Moreover, smart contracts, a core element of blockchain technology, can provide an automated execution function in this system. For example, if Person A pays Person B an agreed-upon amount, then a credit will be autonomously transferred from Person B’s digital wallet to Person A’s digital wallet. All transactions are verified using cryptography.

To generate energy-related credits, smart meter interval data is fed into a cloud database, with meter identification, clean energy verification, energy production data and time stamps autonomously determining when credits should be awarded. Tokenized credits, which are secure digital representations of credits, awarded, traded, and retired via blockchain can dramatically reduce the time and cost associated with tracking and redeeming carbon credits and RECs. These credits will be autonomously generated once requisite conditions are met, and subsequently can be easily tracked from ownership trades to ultimate redemption on a fully transparent, distributed ledger. This transaction process leaves a simple audit trail and enables producers to monetize their credits almost immediately after generation.

Clean Energy Blockchain Network (CEBN) formed a partnership with Silicon Valley Power to apply blockchain technology to simplify their participation in Low Carbon Fuel Standard (LCFS) program. Within this program, as stipulated by the California Air Resources Board (CARB), LCFS credits are awarded to clean fuel providers (of which electric vehicle (EV) charging station owners are becoming an increasing percentage), which may then be sold to dirty fuel producers to offset their carbon emissions. This creates an economic incentive to provide clean fuel.

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Moreover, in the interest of developing additional incentive to use clean fuel, an "enhanced credit" is desirable, which will be awarded when one can prove that the electricity used to charge an EV came from a clean energy source. However, using current accounting and management methods, this verification is quite difficult, preventing enhanced credits from being feasible to administer. Energy tracking via smart meter data, uploaded in near-real time to the blockchain, will enable this beneficial incentive addition to the LCFS program. An important and tangible benefit of such an incentive should be that the ever-expanding quantity of EVs are primarily charged during the day, when solar energy is abundant.

Clean energy certification and assurance is another important offering from CEBN. Energy is often labeled *clean* based on the honor code. In a blockchain enabled process we provide verification of clean energy generated with Association of Energy Engineers (AEE)-certified Energy Auditor standards. This verification activity allows RECs and enhanced LCFS credits transacted on the blockchain platform to originate from prequalified and verified clean energy assets. This verification cuts associated audit time, resources, and costs. These elements, combined with a credit tracking system, comprises CEBN's Blockchain of Custody™ process, with a purpose of automating clean energy verification from credit generation to retirement.

## Conclusion

Overall, it is our strong belief that blockchain technology has the potential to dramatically simplify complex trading environments, while making transactions feasible that were previously prohibitively expensive. This simplification and automation will enable the widespread implementation of socially valuable programs such as LCFS.

The issues associated with current credit accounting and management systems, including the time and cost associated with tracking, reconciling and auditing credits, prevents these socially and environmentally beneficial programs from reaching their full potential. Credits managed by our Blockchain of Custody™ are transparently tracked and undergo near-real time settlement from generation to retirement. By bringing together existing and future stakeholders, we can design and refine an efficient, blockchain-based solution that helps facilitate the widespread implementation of credit programs.

The ultimate goal is to increase consumer access to clean energy and fuel while incentivizing greater production; goals that benefit this and future generations of our communities.

## Author Bios

Mike Ashley, Vice President and co-founder of CEBN, has a PhD in Chemical Engineering from Northwestern University with a BS from the University of Notre Dame. His thesis work was at the interface of chemistry and materials science at the nanoscale, investigating new materials for solar cells and batteries, and he will use this skill set to evaluate emerging clean energy technologies.

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Concurrently, Mike has been working to develop strategies and business models to help accelerate the deployment of clean energy assets, and in particular, blockchain technology for the improvement of REC and carbon credit systems.

Mark Johnson, CEO and co-founder of CEBN, is a ‘grad’ of U.S. Department of Energy, Navigant, IBM Energy/Utilities & Schneider Electric with an MBA from Loyola Chicago and BA from the University of Notre Dame. His extensive clean energy experience helps him connect the dots leading holistic professional teams. Mark successfully teamed on both Shedd Aquarium and IIT nanogrid solar storage projects.