

BLOCKCHAIN TECHNOLOGY IMPACT ON ENERGY MARKET TRANSFORMATION: SECURED DISTRIBUTED ENERGY TRANSACTIONS IN THE CLOUD

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The electricity market is undergoing a transformation. The basic tenet of a centralized production, transmission and distribution system where consumers purchase electricity from a single provider is increasingly developing into a decentralized, multiple provider system centered on renewable energy,¹ in which the customer may produce, consume, and then sell excess electricity capacity like a commodity in an open market, where transactions are transparent, verifiable, and secure. Major drivers of this shift include customer demand for energy independence from the broader electricity grid controlled by utility companies; reduction in energy costs; and the global commitments of influential multinational companies to purchase electricity from renewable energy sources to reduce carbon emissions.² Technology companies have also begun to move into the energy space; Apple's request to become a wholesale provider of renewable energy throughout the country³ was recently approved by the Federal Energy Regulatory Commission ("FERC"). Companies like Apple,⁴ Google,⁵

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¹ See generally *Utility of the Future*, MIT ENERGY INITIATIVE (2016), <http://energy.mit.edu/research/utility-future-study/> [<https://perma.cc/G24T-BCT8>].

² See Andrew Winston, George Favaloro, & Tim Healy, *Energy Strategy for the C-Suite*, HARV. BUS. REV. (Jan.–Feb. 2017), <https://hbr.org/2017/01/energy-strategy-for-the-c-suite> [<https://perma.cc/GJP3-WYJZ>].

³ Apple Energy LLC, Docket No. ER16-1887-000 (Aug. 4, 2016), https://elibrary.ferc.gov/idmws/file_list.asp?accession_num=20160804-3004 [<https://perma.cc/6XP4-896V>].

⁴ *The World's Most Influential Companies, Committed to 100% Renewable Power*, RE100, <http://there100.org/re100> (last visited Mar. 3, 2017) [<https://perma.cc/69RQ-WHFT>].

Amazon⁶ and other non-utility enterprises may ultimately become direct competitors to traditional utility companies in the sale of renewable energy based electricity directly to retail customers through blockchain technology. For now, Apple and Google are authorized to sell excess energy capacity in the wholesale energy markets and could do so with blockchain technology. In the future, if either Apple or Google were to provide energy from renewable sources to customers in retail markets under various distributed energy scenarios, a viable blockchain distributed ledger technology would provide the same seamless, secure and transparent accounting of these transactions.

Blockchain technology is potentially the mechanism to transform energy trading in a decentralized electricity market. The blockchain is a shared and trusted distributed ledger technology that permits the recording of any digital asset transaction between parties over a decentralized encrypted network. Initially developed as a mechanism to record financial transactions using the Bitcoin cryptocurrency financial technology or “fintech,” the blockchain technology has generated broad interest in other business sectors,⁷ including energy trading.⁸ Blockchain technology confirms transactions in real time, and ensures the integrity of transactions through the secured

(Announcing Apple committed to the RE100 goals on Sept. 19, 2016 and discussed the company’s commitments to producing renewable energy and operating its facilities with 100 percent renewable energy).

⁵ *Achieving Our 100% Renewable Energy Purchasing Goal and Going Beyond*, GOOGLE (Dec. 2016),

<https://static.googleusercontent.com/media/www.google.com/en//green/pdf/achieving-100-renewable-energy-purchasing-goal.pdf> [<https://perma.cc/AB6U-HR6J>] (Affirming Google’s, a REI multinational company, commitment to using 100% renewable energy for the company’s facilities by 2017).

⁶ *AWS is committed to running our business in the most environmentally friendly way possible*, AMAZON, <https://aws.amazon.com/about-aws/sustainability/> (last visited Apr. 4, 2017), [<https://perma.cc/9544-C3SH>] (Announcing Amazon’s expansion of the company’s investments in renewable energy production with the development of a Ohio wind farm and Virginia solar farms creating a total of ten renewable energy projects globally).

⁷ *The Promise of the Blockchain: The Trust Machine*, ECONOMIST (Oct. 31, 2015), <http://www.economist.com/news/leaders/21677198-technology-behind-bitcoin-could-transform-how-economy-works-trust-machine> [<https://perma.cc/3S4W-E6EU>].

⁸ *See generally Blockchain – an opportunity for energy producers and consumers?*, PWC GLOBAL POWER & UTIL. (2016), <https://www.pwc.com/gx/en/industries/assets/pwc-blockchain-opportunity-for-energy-producers-and-consumers.pdf> [<https://perma.cc/S5JM-GJXK>].

exchange of digital currency.⁹ Furthermore, the blockchain technology is promoted as beyond the hackers' nefarious reach.¹⁰

Siemens announced on Nov. 21, 2016 an agreement with New York startup LO3 Energy to jointly develop microgrid¹¹ that enable local energy trading through blockchain technology.¹² For example, a provider of electricity from a rooftop solar system would feed excess electricity back into the existing local grid, and receive payments from customers purchasing the renewable energy. The technology being tested stores and validates data that permits direct transactions between energy producers and consumers. In April 2016, successful peer-to-peer ("P2P") energy transactions occurred in Brooklyn, New York between rooftop solar producers of renewable energy and consumers through the use of LO3 Energy's blockchain technology over the company's TransActive Grid.¹³

Various industry analysts have begun to chart the possible implementation of blockchain technology in energy markets. A *Navigant Research* report concluded that while utility companies are exploring the use of blockchain technology, the immediate benefit of the technology is in P2P energy trading among smaller decentralized distributed energy systems such as microgrids, in which owners of distributed energy resources such as solar and wind production facilities sell energy directly to customers.¹⁴ In a *Price*

⁹ Subramanian Iyer, *The Benefits of Blockchain Across Industries*, ORACLE (April 2016), <http://www.oracle.com/us/corporate/profit/big-ideas/041316-siyer-2982371.html> [<https://perma.cc/88XK-LU3X>].

¹⁰ Peter Van Valkenburgh, *Dear Mr. Trump: To 'Cyber' Better, Try the BlockChain*, WIRED (Dec. 20, 2016), <https://www.wired.com/2016/12/dear-mr-trump-cyber-better-try-blockchain/> [<https://perma.cc/8LXE-FPNF>].

¹¹ *Microgrid definitions*, BERKELEY LAB, <https://building-microgrid.lbl.gov/microgrid-definitions> (last visited Apr. 4, 2017) [<http://perma.cc/55N3-KRJ9>] (The United States Department of Energy defines a microgrid as "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.").

¹² Press Release, Siemens, Siemens and U.S. startup LO3 Energy collaborate on blockchain microgrids (Nov. 21, 2016), [http://www.siemens.com/press/en/pressrelease/?press=/en/pressrelease/2016/energymanagement/pr2016110080emen.htm&content\[\]=EM](http://www.siemens.com/press/en/pressrelease/?press=/en/pressrelease/2016/energymanagement/pr2016110080emen.htm&content[]=EM) [<https://perma.cc/L43E-MYCX>].

¹³ *Id.*

¹⁴ Press Release, Navigant Research, Blockchain Technology Could Herald the Start of a New Model for Transactive Energy, <https://www.navigantresearch.com/newsroom/blockchain-technology-could-herald-the-start-of-a-new-model-for-transactive-energy> (last visited Apr. 25, 2017) [<https://perma.cc/H7JW-YMP2>].

Waterhouse study, the company determined that the blockchain technology will support transparent energy supply chain transactions and play a role in energy metering, billing and confirmation of ownership of assets, among other potential benefits.¹⁵

The success in deploying blockchain technology in energy trading markets or any other business enterprise will depend upon how the practical applications of the technology develop, and how those applications will be regulated.¹⁶ Whether the development and use of blockchain technology is driven by open-source agreements, protected by patents and licensing agreements, or a combination of both approaches to deploying the technology is an open question.¹⁷ Furthermore, whether Bitcoin will become the currency of choice in the energy trading markets, or for any other digital market transaction and how the financial transaction is regulated, is an open question. The absence of a single standard or approach to government regulation of the application of the currency transaction applicable to use of the technology in commercial transactions is emblematic of the regulatory hurdles that must be overcome. Federal regulators have pursued different approaches to regulating Bitcoin. The Commodity Future Trading Commission (“CFTC”) has begun to regulate the trading in cryptographic currencies, such as Bitcoin, as financial derivatives.¹⁸ The Office of the Comptroller of the Currency (“OCC”) has requested comments on whether the federal government should create special purpose national banks for fintech companies.¹⁹ The Securities and Exchange Commission (“SEC”) has sought comments on whether transactions using blockchain technology require registration under existing regulations for

¹⁵ PWC GLOBAL POWER & UTILITIES, *supra* note 8.

¹⁶ Trevor I. Kiviat, *Beyond Bitcoin: Issues in Regulating Blockchain Transactions*, 65 DUKE L. J. 569, 569-608 (2015).

¹⁷ Olga Kharif, *Big Banks are Stocking Up on Blockchain Patents*, BLOOMBERG (Dec. 21, 2016, 5:00 AM), <https://www.bloomberg.com/news/articles/2016-12-21/who-owns-blockchain-goldman-bofa-amass-patents-for-coming-wars> [<http://perma.cc/2S7G-NZE8>].

¹⁸ Press Release, CFTC, Keynote Address of CFTC Commissioner J. Christopher Giancarlo Before the Cato Institute, *Cryptocurrency: The Policy Challenges of a Decentralized Revolution* Cato Institute (2016), <http://www.cftc.gov/PressRoom/SpeechesTestimony/opagiancarlo-14> [<https://perma.cc/JK5E-XFSC>].

¹⁹ *Exploring Special Purpose National Bank Charters for Fintech Companies*, AURIEMMA CONSULTING GROUP (Jan. 13, 2017), http://www.acg.net/wp-content/uploads/2017/01/LTR_Exploring-Special-Purpose-National-Bank-Charters-for-Fintech-Companies_01_13_17_JC.pdf [<https://perma.cc/L67L-PNCW>].

transfer agents or clearing agencies.²⁰ The outcome of these domestic questions regarding the legal and regulatory treatment of block chain distributed ledger technology will impact efforts to create standards to govern the use of the technology in domestic and international trade in goods and services now under consideration. Uniform standards on interoperability, data security, and currency payments are imperative if blockchain technology is to become the electronic distributed ledger technology for goods and services, including energy transactions.²¹

In the private sector, the National Association of Securities Dealers Automated Quotations System (“Nasdaq”) has encouraged the use of blockchain technology. Nasdaq announced on Dec. 30, 2015 that “an issuer was able to use its Nasdaq Linq private blockchain ledger technology to successfully complete and record a private securities transaction - the first of its kind using blockchain technology.”²² Furthermore, Nasdaq continues to promote blockchain technology as a transformative technology that ensures efficiency, transparency and data security in financial transactions.²³

On February 28, 2017, a blockchain technology consortium known as the Enterprise Ethereum Alliance (“EEA”)²⁴ was launched by a diverse group of multinational businesses and software developers, including Accenture, Banco Santander, BlockApps, BNY Mellon, BP, Credit Suisse, Cryptape, ING, Intel, J.P. Morgan, Microsoft, String Labs, Thomson Enterprise. The EEA was created to further the development of a free to use, open source industry standard for blockchain solutions to serve as the foundation for

²⁰ See Mary Jo White, Chair, Securities and Exchange Comm’n, Keynote Address at the SEC-Rock Center on Corporate Governance Silicon Valley Initiative (2016); SEC Transfer Agency Regulations, 17 C.F.R. § 240 (2015), <https://www.sec.gov/rules/concept/2015/34-76743.pdf> [<https://perma.cc/TQ2C-QDH7>].

²¹ See *Blockchain Enabled Distributed Energy Trading, Executive Summary*, NAVIGANT RESEARCH (2016), <https://www.navigantresearch.com/research/blockchain-enabled-distributed-energy-trading> [<https://perma.cc/3XJQ-ZC44>]; Alexander Shelkovnikov, *Blockchain applications in energy trading*, DELOITTE (2016), <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/energy-resources/deloitte-uk-blockchain-applications-in-energy-trading.pdf> [<https://perma.cc/2PAS-DFKZ>].

²² *Nasdaq Linq Enables First-Ever Private Securities Issuance Documented with Blockchain Technology*, NASDAQ (Dec. 30, 2015), <http://ir.nasdaq.com/releasedetail.cfm?releaseid=948326> [<https://perma.cc/9XJF-W9RK>].

²³ *Building on the Blockchain*, NASDAQ (March 23, 2016), <http://business.nasdaq.com/marketinsite/2016/Building-on-the-Blockchain.html> [<https://perma.cc/77WR-H7UE>].

²⁴ ENTER. ETHEREUM ALLIANCE, <http://entethalliance.org> (last visited Apr. 15, 2017) [<https://perma.cc/K8V5-TSFY>].

business transactions by ensuring transparency, trust, privacy, and performance in peer-to-peer and multiparty agreements among other applications.²⁵ According to Jeremy Millar, founding board member of EEA, “Ethereum is already one of, if not the, most widely used technologies for developing and deploying enterprise blockchains. Enterprises love the availability of open-source implementations, a single standard, the rapidly growing developer ecosystem, and availability of talent. But enterprises expect resilient secure systems and a robust controls environment. EEA aims to bring these together, both to provide enterprises the forum they need and also to advance Ethereum generally.”²⁶

The response of government regulators to unanswered questions regarding the regulatory treatment of the technology and how best to exploit the use of blockchain distributed ledger technology in the trading of goods and services are expanding. On February 9, 2017, Congressmen Jared Polis (D-Colo.) and David Schweikert (R-AZ) announced the launch of the Congressional Blockchain Caucus.²⁷ The bipartisan caucus is “dedicated to the advancement of sound public policy toward blockchain-based technologies and digital currencies.”²⁸ Congressman Schweikert has replaced former Co-Chair of the Blockchain Caucus Rep. Mick Mulvaney (R-S.C.) who was recently confirmed as President Trump’s Director of the Office of Management and Budget. The importance of harnessing the value of blockchain technology in domestic and international commerce is reflected in the comments of Congressman Schweikert, “Open blockchain networks and distributed ledger technologies are still new, but it’s critical for members of Congress to begin comprehending both their current applications and future use cases” and that “it is critically important the United States remain competitive regarding emerging technologies, and distributed ledger technology is the open, secure, efficient technology backbone we’ve been looking for.”²⁹ Recently, the United States Department of Energy (“DOE”) requested proposals on the use of blockchain distributed ledger technology to

²⁵ Press Release, Enter. Ethereum Alliance (Feb. 28, 2017), <http://entethalliance.org/wp-content/uploads/2017/02/EEA.pdf> [<https://perma.cc/HP5C-EQWK>].

²⁶ *Id.*

²⁷ Press Release, Jared Polis 2nd Dist. of Colorado (Feb. 9, 2017), <http://polis.house.gov/news/documentsingle.aspx?DocumentID=398291> [<https://perma.cc/K72D-3NBC>].

²⁸ *Id.*

²⁹ *Id.*

ensure the security of energy transactions.³⁰ The request for proposals states that “DOE is currently investigating novel approaches to leverage and explore blockchain technology, initially developed within the financial sector, for the realization of robust fossil energy-based systems” and that “proposals are sought to develop novel concepts for energy systems that rely on blockchain technology to assure robust systems that are less susceptible to cyber-attack.”³¹

With the rise of fintech, a global effort is underway to create universal standards for seamless, transparent and secured electronic commercial transactions based upon the blockchain distributed ledger technology. The International Organization for Standardization (“ISO”), an independent, non-governmental international organization that develops standards in response to global challenges,³² has established a technical committee, ISO/TC 307, to develop voluntary standards for the use of blockchain distributed ledger technology in national and international trade in goods and services.³³

Based upon the proposal of Standards Australia³⁴ to the ISO in 2016,³⁵ the mandate of the technical committee is development of global “standardization of blockchains and distributed ledger technologies to support interoperability and data interchange among users, applications, and

³⁰ U.S. DEP’T OF ENERGY, SMALL BUSINESS INNOVATION RESEARCH (SBIR) AND SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAMS 64 (2016), https://science.energy.gov/~media/sbir/pdf/TechnicalTopics/FY2017_Phase_1_Release_2_Topics_Combined.pdf [<https://perma.cc/VV9S-VCHZ>].

³¹ *Id.*

³² Google used ISO 50001 modeling standards as “a framework to establish a more structured and formalized energy management system” to achieve the company’s energy efficiency goals. *Google Creating a More Energy-Efficient Web*, ISO FOCUS 41-42 (Nov.–Dec. 2016), [https://www.iso.org/files/live/sites/isoorg/files/news/magazine/ISOfocus%20\(2013-NOW\)/en/2016/ISOfocus119/ISOfocus_119.pdf](https://www.iso.org/files/live/sites/isoorg/files/news/magazine/ISOfocus%20(2013-NOW)/en/2016/ISOfocus119/ISOfocus_119.pdf) [<https://perma.cc/46HM-PR5H>].

³³ *ISO/TC 307: Blockchain and Electronic Distributed Ledger Technologies*, INT’L ORG. STANDARDS (2016), <https://www.iso.org/committee/6266604.html> [<https://perma.cc/8V5C-LQ7Y>].

³⁴ The national standards authority of Australia. STANDARDS AUSTRALIA, <http://www.standards.org.au/Pages/default.aspx> (last visited Mar. 31, 2017) [<https://perma.cc/8S5F-XX4Y>].

³⁵ The April 2016 proposal of Standards Australia (SA) for standardization of blockchain and distributed ledger technologies was approved by the ISO Technical Management Board in September 2016. It allocated the leadership of the technical committee to SA. *See* ARTHUR COX, PROPOSAL FOR STANDARDISATION OF BLOCKCHAIN AND ELECTRONIC DISTRIBUTED LEDGER TECHNOLOGIES (2017), <http://www.arthurcox.com/wp-content/uploads/2017/02/Proposal-For-Standardisation-of-Blockchain-and-Electronic-Distributed-Ledger-Technologies.pdf> [<https://perma.cc/U9RP-C5TB>].

systems.”³⁶ The work of ISO/TC 307, under the leadership of Standards Australia, commenced in Sydney, Australia on April 3-5, 2017.³⁷ The United States, Canada, China, Germany, Japan and Russia are among seventeen participating ISO members while Argentina, Iran, Israel, and South Africa are among seventeen observing ISO members.³⁸

The scope of economic, legal, and regulatory parameters for the use of blockchain distributed ledger technology in public and private exchanges is evolving and may take decades to be fully realized.³⁹ As this occurs, the technology will continue the transformation of electricity market energy supply transactions. Navigant has described this evolution as the emergence of a decentralized energy marketplace, an “energy cloud,” in which blockchain technology can serve as a secure digital ledger for energy transactions.⁴⁰ The nexus between private sector innovation and limited government regulations, however, will determine whether blockchain technology transforms the global economy in goods and services, including distributed energy transactions.⁴¹ The results of the ISO/TC 307 will greatly impact the evolution of blockchain distributed ledger technology as a viable records keeping component in national and internal supply chain management of energy transactions.

³⁶ INT’L ORG. STANDARDS, *supra* note 33.

³⁷ *Id.*

³⁸ *Id.*

³⁹ Marco Iansiti & Karim R. Lakhani, *The Truth About Blockchain*, HARV. BUS. REV. 118 (Jan.–Feb. 2017).

⁴⁰ *Navigating the Energy Transformation*, NAVIGANT (Aug. 24, 2016), <https://www.navigant.com/insights/energy/2016/navigating-the-energy-transformation> [<https://perma.cc/4WDU-BS9W>].

⁴¹ *See* Conference Report, Nat’l Ass’n of Regulatory Util. Comm’rs, Winter Committee Meetings: Staff Subcommittee on Rate Design, (Feb. 12, 2017), <http://pubs.naruc.org/pub/DABCE1BC-F671-0770-723D-69BC12DF630A> [<https://perma.cc/MD4X-529V>]. Presentations about blockchain technology were made by the following participants: Matt Byron, Ernest & Young (“Introduction to Blockchain”); Lawrence Orsini, LO3 Energy (“Distributed grid solutions that bring people, utilities and technology together”); Ravi Pradhan, Siemens (“Hierarchical Energy Markets Enabled by Blockchain”); Lynne Kiesling, Northwestern University (“Economic Implications of Blockchain for Electricity Distribution and Markets”).