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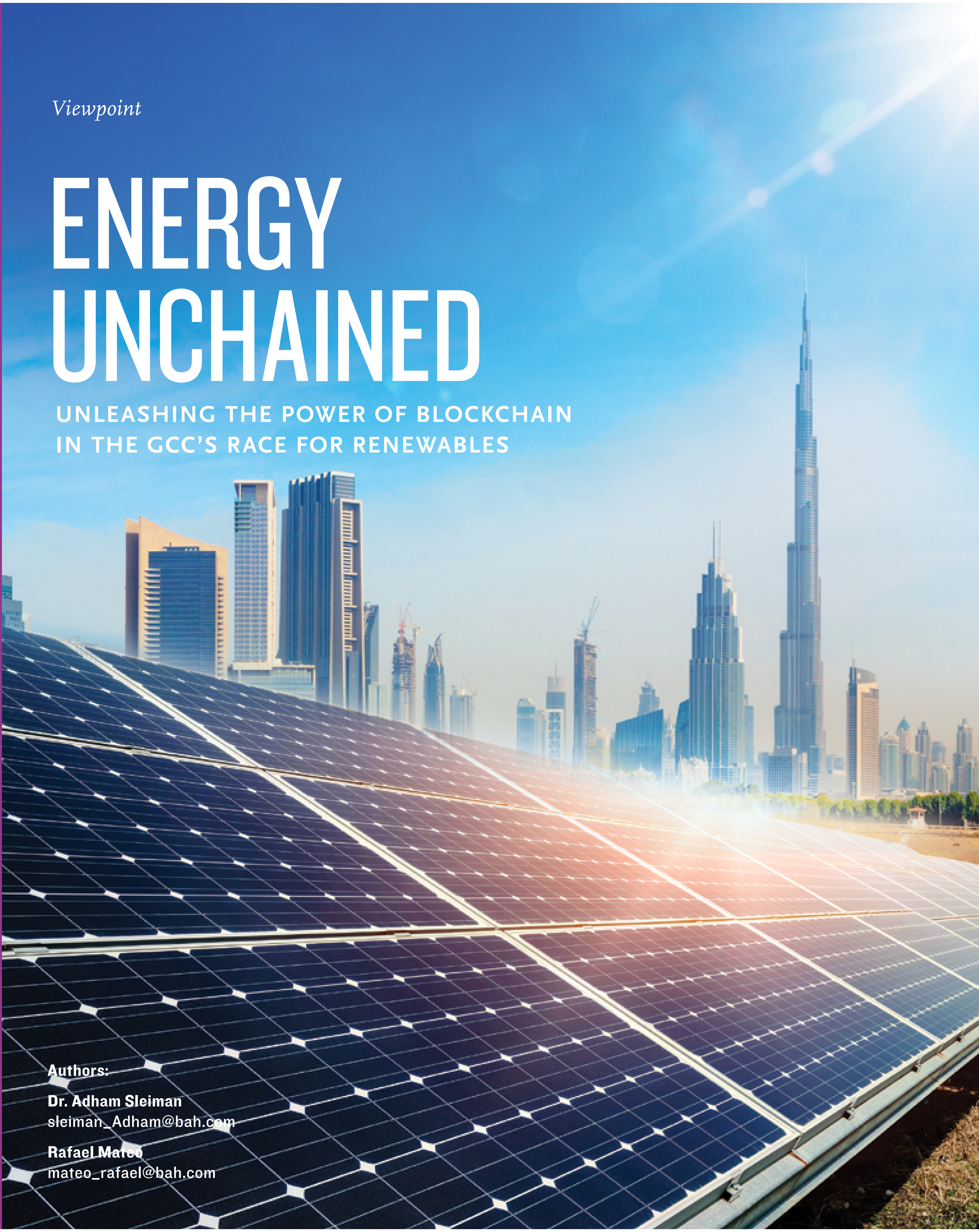

Viewpoint

ENERGY UNCHAINED

UNLEASHING THE POWER OF BLOCKCHAIN IN THE GCC'S RACE FOR RENEWABLES

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INTRODUCTION

Blockchain is being discussed as the technology that will change the business world as we know it today. Since its conceptualization for the development of Bitcoin in 2008, the interest in this technology has exponentially increased and expanded into many different industries, with its global market predicted to grow to USD 2.3 billion by 2021 [1]. The promise of an encrypted digital solution, capable of democratizing entire sectors, is galvanizing advocates of what has been called the Fourth Industrial Revolution.

However, despite the impact blockchain may have on different industries and its clear potential to disintermediate and shorten entire value chains, the technology is still young. Organizations are just starting to explore its application to traditional business models and processes, and players in the energy space, including start-ups and large-scale utilities, just started two years ago to engage with this technology by defining use cases and implementing proof of concepts to explore its real potential.

With renewable energy and, in particular, distributed energy resources, gaining traction in the GCC, the way in which blockchain could impact the power industry in this regard is still unclear.

Blockchain may effectively facilitate the development of new renewable energy markets, and even play a game-changing role in the electricity system's transition to a more secure, resilient, cost-effective, and low-carbon grid. But at the same time, blockchain should be seen as just one of many technologies that could underlie the next-generation service infrastructure in the energy sector.

Many digital services are already possible today without blockchain, and energy players should avoid adopting this technology simply for its own sake or through fear of missing out. Early adopters should conduct a holistic assessment to understand their own role in the energy value chain, identify the business need and define a clear direction of where and with what economic benefits blockchain-based applications could be used.

The purpose of this paper is to provide an overview of the potential applications of blockchain in the renewable energy space and to reflect on how utilities in the GCC could approach the shift towards a renewable, decentralized and local power grid. Amongst the key issues, the paper explores how utilities can retain their competitive advantages and leverage blockchain technology, where appropriate, to unlock new sources of value for their customers and shareholders.

[1] "Size of the blockchain technology market worldwide from 2016 to 2021", Statista.com

RENEWABLE ENERGY OUTLOOK IN THE GCC

[2] "New Energy Outlook 2018", Bloomberg New Energy Finance

[3] "GCC Energy System Overview," The King Abdullah Petroleum Studies and Research Center (KAPSARC), 2017

[4] Source for Oman data: "OPWP's 7-year Statement 2018 – 2014", Oman Power and Water Procurement Co., May 2018

[5] "Renewable Energy Market Analysis: The GCC Region", IRENA, 2016

[6] "Energy Storage Trends and Opportunities in Emerging Markets", Navigant Research, 2017

According to a report from Bloomberg New Energy Finance [2], the world will generate almost 50 percent of its electricity from renewable energy by 2050. The cost of an average photovoltaic (PV) plant is expected to fall by more than 70 percent, with wind technology getting cheaper too, dropping by almost 60 percent, and battery improvements causing a dramatic drop in storage costs. Combined, these developments stand to reshape the electricity system as we know it.

GCC countries are naturally positioned to embrace this new reality and the regional governments are embarking on ambitious plans to invest in renewable energy and achieve significant targets by 2030. With electricity demand in the region expected to continue growing rapidly, driven by population growth, urbanization, rising income levels, industrialization, water desalinization, and low electricity prices, renewable energy has become a key asset in government strategies to diversify the domestic energy mix.

By 2030, the GCC aims to install more than 80 gigawatt (GW) of renewable energy capacity across the six member states, constituting more than fifty percent of the region's existing conventional capacity. At the country level, Saudi Arabia intends to install 9.5 GW of renewables by 2023. Meanwhile, Qatar and Kuwait have set targets of 1.8 GW and 5.3 GW, respectively, to be achieved by 2030. For its part, Dubai has stated that 25 percent of its electricity will be solar generated by the same year, while Abu Dhabi is aiming for solar to account for seven percent of installed capacity by 2020. Last but not least, Bahrain has set a target of five percent, also to be attained by 2020 [3] and Oman intends to install 2.65 GW of renewables by 2024 (Fig. 1) [4].

It has been estimated that achieving these renewable energy targets could result in cumulative savings of 2.5 billion barrels of oil equivalent (2015-2030), which may lead to savings of between USD 55 billion and USD 87 billion for the GCC economies [5].

The approaches that different GCC economies have adopted for their renewable energy strategies are diverse, with some relating to specific solar-centric technologies, given the abundance of solar resources in the Gulf states.

Differences can also be appreciated in the scale of the projects implemented. As in many other geographies, the centralized grid model in the GCC has naturally enabled large-scale renewable developments. But at the same time, the region is exploring the deployment of distributed energy resources (DER, understood as distributed generation and distributed storage), as a way to achieve the ambitious objectives of its green national strategies.

Already, exploration of distributed generation has led to tangible action. For instance, Shams Dubai, a smart initiative to connect solar energy to buildings, allows UAE consumers to credit their surplus solar PV energy to the grid. The excess energy is then offset against their bills.

Innovative models such as this are helping to nurture a new electricity market for small and medium scale solar producers. In doing so, they are also responding to the increasing interest of consumers in becoming 'prosumers' (both producers and consumers) and joining the energy trading marketplace.

Distributed storage, intrinsically linked to a decentralized renewable grid, is also being revealed as a viable alternative to grid-scale storage, and the deployments and market value are expected to grow exponentially in the coming years across the MENA region [6].

COUNTRY	RENEWABLE TARGETS	YEAR
BAHRAIN	5% of installed capacity	2020
KUWAIT	CSP = 5.7 GW	2030
	Solar PV = 4.6 GW	
	Wind = 0.7 GW	
	15% of generation	
OMAN	2.65 GW	2024
	10% of generation	2025
QATAR	1.8 GW solar	2030
	20% of generation	
SAUDI ARABIA	1.8 GW solar = mix of wind, solar PV, CSP solar and waste-to-energy	2023
UAE	ABU DHABI : 7% of installed capapcity	2020
	DUBAI : 25% of electricity supply	2030
	DUBAI : 75% of electricity supply	2050

Fig. 1. GCC renewable energy targets

MAIN CHALLENGES OF RENEWABLE ENERGY INTEGRATION

[7] "Renewable Energy Market Analysis: The GCC Region", IRENA, 2016

The transition from traditional energy sources to renewables in the region poses several challenges to power utility companies, and those challenges differ in type, scale, and magnitude. They affect multiple components of the traditional power sector value chain and can be classified into the following categories:

- Institutional and governance challenges
- Supply and technical challenges
- Demand and commercial challenges

Institutional and Governance Challenges

GCC countries have set up ambitious renewable energy plans for 2030. For these plans be successful, an effective institutional framework is required to help ensure that countries' energy targets are met. Regulations and policies that facilitate sustainable revenue streams for the future renewable energy model, and that are conducive to the creation of an attractive investment climate, are important components of such a framework.

In the GCC, utility sector policy formation is usually a task for the ministries of electricity and water, while regulations tend to fall under the remit of non-ministerial entities, such as the Electricity and Cogeneration Authority in the case of Saudi. In Qatar, the country's General Electricity and Water Corporation (Kahramaa) is supplier and regulator in one, while in Oman, responsibility lies with the Authority for Electricity Generation.

On top of this, some GCC nations have formed specific bodies focused on renewable and sustainable energy in order to facilitate the realization of their future energy visions. For example, KACARE in Saudi Arabia has been created to develop the kingdom's renewable energy landscape, while the UAE has established the Directorate of Energy and Climate Change, a separate entity within the Ministry of Foreign Affairs [7].

Despite the progress made in recent years, the institutional frameworks of GCC members are still not mature enough to effectively execute their renewable energy visions. Governments should maintain focus on building institutional capacity, defining clear responsibilities, ensuring coordination between entities, and mandating them with the design of sound renewable energy plans with clearly stated timeframes. These measures are vital in charting the course for the sector's development and in boosting investor confidence.

This represents a major challenge, particularly for regulatory authorities. The regulatory authorities in the GCC need to adopt an agile and flexible approach in order to articulate solutions to complex issues around the integration of renewables in the power system. Examples of such regulatory challenges include: electricity rates reforms to accommodate time-of-use (TOU) rates or a compensation model for DER; new governance models and processes for the electricity market; license models for new market players which might not be as structured, mature, or stable as existing utility companies; utility ownership of assets and alternative business models; or, collaboration schemes with private entities, including as-a-service schemes.

Supply and Technical Challenges

[8] "Integrating Renewable Electricity on the Grid", American Physical Society

Developing renewable resources presents a set of technological challenges not previously faced by the grid, mainly driven by the variability of renewable generation, which introduces uncertainty in generation output. Although small penetrations of renewable generation on the grid can be smoothly integrated, it has been estimated that accommodating more than 30 percent of electricity generation from renewable resources requires new approaches to operating and planning the grid [8]. This is because the uncertainty in the availability of renewable resources threatens the most critical priority of any system operator: ensuring the reliability of the grid. Indeed, the assurance of grid reliability is what actually drives up the cost of renewable integration, as operators must have contingency plans in place to cover any unexpected loss of renewable generation.

These contingency plans for backup generation are typically articulated through different mechanisms, which necessarily implies additional challenges and investments on top of the renewable infrastructure. Here, examples include: ramping conventional reserves up or down, developing weather forecasting capabilities so that renewable generation can be more accurately predicted, deploying a smart grid including a distribution automation infrastructure, upgrading legacy storage infrastructure, or implementing new operating procedures for fast response to accommodate generation ramps such as up-ramps at times of low demand and down-ramps at times of high demand.

As DER penetration grows, the challenges become bigger at the edge of the grid due to an increase in the number of energy feed-in points, meaning utilities must adapt the distribution grid to handle two-way power flows and potential congestion of the distribution network.

[9] "GCC Energy System Overview – 2017", KAPSARC

Demand and Commercial Challenges

Adopting large-scale renewable energy resources often requires significant investments in technology, which differ from legacy infrastructure deployed in most cases during the last century.

In an industry with relatively low margins and limited cash on hand, utilities companies have explored the option of increasing tariffs to create a potential source of funding for the deployment of this renewable infrastructure. However, the increase of electricity tariffs constitutes a double challenge for utilities in GCC:

Firstly, an increase in tariffs is hard to justify with renewable energy sources, which theoretically have a marginal cost of zero. What's more, customers would expect a reduced tariff in the medium and long term.

Secondly, the regulated price of energy in GCC member states limits the flexibility of utilities to define their own pricing strategies. In order to guarantee access to energy and to shore up economic development, the region's governments have traditionally retained control of energy assets, supplying energy at highly subsidized rates for both domestic and commercial use. As a result, energy prices in the GCC are amongst the lowest in the world [9].

Given the unsuitability of tariff increases, the industry has also explored the capital markets as an alternative to finance the deployment of renewable infrastructure. However, GCC utilities struggle to justify to investors or financial institutions the business case for these massive projects, given their relatively long pay-back periods and the limited ability to collect additional revenues.

[10] "MENA power investment: finance and reform challenges persist," APICORP Energy Research, April 2017

[11] "The State of Electric Utility", Utility Dive, 2017

[12] "How leading utilities are planning for distributed energy resources," Utility Dive, Feb 2018

Indeed, financing projects continues to be an extended issue in MENA. Efforts to attract foreign investment have met with only limited success amid ongoing concerns over the region's political and economic landscape, while credit worthiness has failed to improve on the average BBB sovereign rating issued by Standard & Poor's. As a result, investor confidence remains sub-par [10].

At this point, incentivizing DER should seem an alternative, feasible solution for GCC utilities to address the challenges described above. This approach implies less investment requirements for the utility and a reduction in the overall demand, which would minimize the need for electricity subsidies or financing sources.

However, the positive effects do not exempt them from additional commercial complications. As DER become more popular, utilities are forced to rethink their rates structures once more. Though the majority of the revenues from utility rates are derived from variable, volume-based rates, the costs related to delivering power and maintaining the grid are largely fixed. When confronted with stagnant growth in electricity sales, recovering these fixed costs becomes all the more challenging—a situation exacerbated by reduced electricity demand amongst consumers as DER proliferation continues [11].

Few utilities are seeing DER penetrations today that threaten reliability or revenues, but most are beginning to prepare for such eventualities, entering regulatory discussions about grid modernization, DER compensation and other associated issues [12].

IMPACT OF DISTRIBUTED ENERGY RESOURCES ON THE POWER VALUE CHAIN

Distributed energy resources are modular energy generation and storage technologies that provide electric capacity or energy where needed. Typically in the range of 3 kilowatt (kW) to 50 megawatt (MW) of power, DER systems may be either connected to the local electric power grid or isolated from the grid in stand-alone applications [13]. DER have been available for many years, but it is today, with the expansion of green national strategies in the GCC and the renewable technology cost drop, that they have reached the potential to disrupt the electricity value chain. For the purpose of this paper, we will look at renewable-based distributed generation and distributed storage.

The deployment of DER means that utilities no longer fully control power generation and retail, enabling customers to take greater control of their electricity needs, address environmental worries, guarantee access to electricity, increase energy independence and reduce costs. Utilities were once the only option; now power is literally in the hands of the everyday consumer [14].

By both consuming and producing energy, customers are now playing a key role in the decentralized grid. These 'prosumers' are able to manage their use of electricity, exchanging services with their peers and using aggregators and utilities to supply electricity services to the grid. This shift towards a participatory and highly networked model is transforming the traditional energy value chain at the distribution level by enabling suppliers and consumers to interact with the grid [15].

GCC energy players must be aware that the shift to renewable and distributed energy resources has instigated a shift in the entire layout of the conventional centralized grid. The grid has begun its transition to more decentralized models in which the different stakeholders need to find their roles.

[13] "Using Distributed Energy Resources", Federal Energy Management Program, U.S. Department of Energy, National Renewable Energy Laboratory

[14] "The State of Electric Utility", Utility Dive, 2017

[15] "Implementing Distributed Energy Resources," GE, 2018

BLOCKCHAIN CONTRIBUTION TO RENEWABLE ENERGY INTEGRATION

[16] "Blockchain: Application to Financial Services in the GCC Region", Booz Allen Hamilton, 2016

[17] "Blockchain 101", Consensys, presented at the Future Blockchain Summit, Dubai, May 2018

[18] "Energy Blockchain Startups Raised $324 Million in the Last Year. Where's the Money Going?",Greentechmedia, March 12, 2018

Blockchain is a transaction database based on a shared/decentralized ledger, which records all the transactions ever executed in chronological order like a 'chain'. Transactions processed by the blockchain are validated by the members of the network, avoiding the need for a third party to coordinate interactions. Initially used to validate and process Bitcoin transactions, it can be used to track and monitor the exchange of information or value more broadly [16].

Blockchain is not a new technology. Peer-to-peer file sharing, used to disseminate a copy of data to an undefined number of network nodes, was first demonstrated in 1999. Prior to that, smart contracts, understood as the technology to enable self-enforcing agreements, were invented in 1994. Going even further back, the public-key cryptography, used to uniquely identify the owner of an account in order to authorize data modification, was developed in the 1970s, as were the cryptographic hash functions, used to link transactions into verifiable chains [17].

The real value of blockchain, and the innovation that is making this technology a potential disruptor for so many industries today, is the business model underlying it. Blockchain enables decentralization in systems in which central authorities have traditionally played a key role. The role of the central authority can now be assumed by individuals within the network, who receive rewards (usually in the form of tokens) in exchange for resources that validate the transactions and keep the system running.

Renewable energy is a good candidate for blockchain use. It operates in a system of economic and financial transactions (electricity and fares) and the central authority that is currently operating the system (utility) is gradually becoming more decentralized thanks to the role that distributed energy resources are playing.

In this context, energy players are increasing their efforts to develop blockchain-based applications and processes in order to solve some of today's challenges, while also integrating renewable energy in traditional grids. Between the second quarter of 2017 and first quarter of 2018, blockchain startups in the energy sphere raised USD 322 million in the form of venture capital and initial coin offerings. Now, as utilities explore the potential uses of blockchain in customer billing, transactive energy, data collection and the management of DER, they too are investing directly. To mention a few examples, companies such as Centrica, RWE and Tepco have made investments in blockchain startups within the last year, with many others such as EON and Engie working with consortia like the Energy Web Foundation [18].

Across the different experiences of the last two years, we have identified three specific use cases in which blockchain can facilitate the integration of renewable energy in electricity grids across the GCC:

- Enabling P2P Energy Trading
- Tracking Renewable Energy Certificates
- Articulating Smart Contracts

ENABLING P2P ENERGY TRADING

According to the International Energy Agency, by 2040, one billion households and 11 billion smart appliances could actively participate in interconnected electricity systems [19]. Transactive energy, enabled by distributed energy resources, is the major disruptive change that the electricity industry may face in the coming 10 years [20].

Pure peer-to-peer (P2P) scenarios are not likely to happen [21], due to regulatory constraints and the natural reservations of consumers to spend time and effort in this procurement process. However, the fact is that 57 percent of the money raised by blockchain startups operating in the energy space is heading towards transactive energy [22].

Indeed, the first experiment of blockchain in the energy sector was a transactive energy project: The Brooklyn Microgrid. In this pilot, implemented at the beginning of 2016, residents with PV systems could sell their power in the neighborhood without the intermediation of the utility, using the Ethereum blockchain, an open-source, public, distributed platform that enables smart contract functionality.

The pilot was led by startup, LO3 Energy, and illustrated the ability of a blockchain ecosystem to monitor flows of both value and energy as multiple parties transact. Compelled by the findings, Siemens began collaborating with the startup on blockchain microgrid research just six months after the project's launch. Two years on, 122 organizations have become involved in blockchain technology and 40 projects have been deployed [23], mainly focused on the transactive energy space.

[19] "Digitalization and Energy", International Energy Agency, 2017

[20] Lawrence Orsini, LO3 CEO, during the presentation of "A Reimagined Energy Marketplace", presented at Future Blockchain Summit, Dubai, May 2018

[21] Jeffrey Char, TRENDE CEO, during the presentation of "Building Decentralized Energy Systems Using Blockchain", presented at Future Blockchain Summit, Dubai, May 2018

[22] "Blockchain for Energy 2018: Companies & Applications for Distributed Ledger Technologies on the Grid", GTM Research

[23] "Blockchain's Potential for Managing the Impact of Renewables and Peer-to-Peer Sales," Renewableenergyworld.com, April 2018

TRACKING RENEWABLE ENERGY CERTIFICATES

It is impossible to distinguish electricity generated from renewable energy from electricity produced by other means. Therefore, it is important for utilities to make use of tracking tools such as renewable energy certificates (REC) that track renewables as they flow into the grid. However, while the certificates can be useful, the authenticity of RECs is sometimes challenged, with the market yet to be fully convinced that RECs represent genuine green energy.

One alternative that is rising to the fore is blockchain tokens. Just as blockchain technology enables users to transact money or data without the need for a third party, blockchain tokens can be submitted to the market as units of energy, in the same way as RECs.

These tools enable consumers to obtain tokenized REC directly from the producers, and circumvent energy providers in the process [24].

Utilities are also starting to explore the benefits of extracting more value from already-generated renewable energy through a dedicated digital currency. In January 2018, Saudi Arabia's ACWA Power became the first large scale generator to adopt SolarCoin. This energy-referenced crypto currency aims to incentivize global solar energy production by disbursing digital coins to verifiably produced solar energy. By leveraging SolarCoin, ACWA Power will be rewarded with digital tokens at the rate of one SolarCoin per megawatt hour of solar energy produced. The 50MW Bokpoort CSP project in South Africa and the 50MW Karadzhalovo PV plant in Bulgaria are already generating SolarCoins, and the company expects to include other projects under the program soon [25].

[24] "Cryptocurrency as guarantees of origin: Simulating a green certificate market with the Ethereum Blockchain", J. Alejandro F. Castellanos, Debora Coll-Mayor, José Antonio Notholt, 2017

[25] Acwapower.com

ARTICULATING SMART CONTRACTS

The development of blockchain in the energy sphere can be viewed in line with the evolution of three phases: Blockchain 1.0, 2.0, and 3.0. The first phase—Blockchain 1.0—is characterized by the deployment of cryptocurrencies in place of other existing digital payment systems. The second phase sees the use of blockchain extended to smart contracts and increasingly sophisticated financial instruments. For its part, Blockchain 3.0 is yet to mature, but it will do so when the role of blockchain is realized in the fields of big data and predictive task automation [26].

While smart contracts are extremely useful and the key to decentralization systems, the concept is less sophisticated than one might think. Smart contracts are self-executing programs that respond to a pre-defined trigger event. Once the action is done, it's added to the blockchain as a permanent record. What makes smart contracts unique is that their existence on the blockchain enables a code that self-executes without the need for third parties, thus improving transactional efficiency and reducing error and fraud.

RWE, one of Germany's biggest energy and gas providers, deployed hundreds of electric vehicle (EV) charging stations all over Germany, operated through smart contracts based on Ethereum's blockchain.

RWE's solution makes use of three different types of smart contract that exist on the Ethereum blockchain: LibManager, MobilityToken and ChargingPoles. The first of these three allows contracts to be updated in case bugs are found or fixes are required, by enabling contracts to hold references to other contracts. MobilityToken, meanwhile, holds balances and enforces the regulatory framework. Third, ChargingPoles, serves as a registry of all charging poles and onboards the logic necessary to process charging station operations [27].

Through this initiative, the utility plans to enable a fully automated, worldwide authentication, charging and billing solution for EVs with no middleman involved. This will make the operation quicker and more efficient, and will equip individuals and companies to play a role in the future of private mobility.

In addition to the end user experience, there are a number of further benefits that add to this solution's superiority over centralized alternatives. First, the charging station handles user authentication, loyalty points and payment processing on RWE's behalf, in a single transaction. Secondly, it aims to remove the need for a centralized server by making use of the public blockchain—in RWE's case by leveraging a shared resource and paying for nothing other than what is used. Thirdly, the solution ensures fraud-proof accounting, thanks to the transparency of all transactions that take place on the blockchain. This in particular has positive implications for the future regulatory environment. Finally, blockchain facilitates the onboarding of channel partners thanks to open application programming interfaces [28].

Full-scale deployment will be possible as far as EVs are equipped with blockchain capabilities, but this experience represents the first step in setting up the basic infrastructure for machines to autonomously transfer value, showing the role that utilities may play in the future ecosystem.

[26] "Blockchain and smart contracts: Pioneers of the energy frontier", C. Burger & J. Weinmann, International Business Times, December 15, 2017

[27] "Innogy Charges New Electric Car Fleet Using Ethereum Blockchain," Bitcoinmagazine.com, May 5 2017

[28] "Partnering with RWE to explore the future of the Energy Sector", S. Tual, slock.it

HOW UTILITIES SHOULD RESPOND TO THIS NEW PARADIGM

We have described the main challenges around renewable energy integration and highlighted a few examples of how utilities can use blockchain applications in their efforts to overcome them. However, most of the current applications only aim to solve portions of the energy market problems. As such, utilities should consider a wider and deeper approach in the process of exploring and adopting this technology. A holistic framework for utilities is proposed to leverage blockchain technology and find their role in the future renewable, decentralized, electricity value chain.

[29] "Digital media revenue worldwide from 2016 to 2022", Statista.com

UTILITIES MISSION:

COMPANIES SHOULD PUT THE ACCENT BEYOND ENERGY DELIVERY

During the early 2000s, telecommunication operators addressed one of the biggest business transformation journeys in their history. The deployment of fixed and mobile broadband and the high penetration of smartphones enabled a new market of digital content with several players competing to capture that value. Telecom operators had to face the decision of keeping the focus on their traditional business (remain pure channel providers) or jump to compete in a new digital market as channel and content providers. Today, the digital media market is estimated to be worth more than USD 100 billion [29], with many telecommunication operators becoming leaders in the field.

The utilities industry today is witnessing a similar paradigm shift enabled by technology, and utility companies should take advantage of the lessons learned by the telecom industry 15 years ago. In particular, they should note how world-class leaders were able to quickly adapt their visions and missions to capture the opportunity to develop new business models.

The mission of utility companies has been clear from the outset: to generate, transmit and deliver electricity to their customers. Utilities operate networks that in some cases include assets that are more than 100 years old and the processes and business models used often have seen similar static development.

However, the landscape is changing, with the utility now being impacted by technology in the same way the

telecommunication industry was in the early 2000s. The ownership of the network infrastructure is not the key competitive advantage anymore, and new business models beyond energy delivery are emerging thanks to technological advances, with several industries competing to capture this value. As an example, electric vehicles will represent nine percent of global electricity demand by 2050 [30] and three different industries, (Financial Services, Energy and Automotive) are converging to capture the opportunity of the digital payments markets around EV charging. In sum, different players are exploring value propositions that will define how the electricity value chain will look in the future.

GCC utilities have the opportunity to take a lead role in this new ecosystem. EV charging offerings, prosumer technology infrastructure and distributed storage solutions are just a few examples of what customers will demand from the future electricity landscape. Over the long term, blockchain is expected to add business value to the emerging utility business models such as local energy markets, virtual power plants, energy communities [31], EV charging and renewable energy certificates, in which a traditional utility or supplier plays the role of business and technology facilitator.

The success of GCC utilities in capturing this value is necessarily linked to their ability to reinvent themselves by adapting their vision and mission to become not only energy deliverers, but providers of the next layer of electricity value-added services. A quick look at the vision statements of utilities in the region demonstrates that there is room for improvement towards this strategic reflection.

[30] “New Energy Outlook 2018,” Bloomberg New Energy Finance

[31] “Blockchain for Power Utilities: A View on Capabilities and Adoption,” Cognizant, March 2018


71.19
29.98
215
505
682
790
895
925
-0.26
457
-0.07
397
-0.17
634
517
2.07
477
514
0.18
-0.14

SERVICES:

BLOCKCHAIN APPLICATIONS MUST SOLVE REAL BUSINESS NEEDS

The blockchain applications highlighted, offer examples that utilities may wish to consider when building their new energy portfolios. However, as with any technology deployment, the business need has to be the starting point. As such, utilities should consider first how the technology could help to solve issues or enhance business processes across the industry value chain. Blockchain is just one of many technologies that could underlie the next-generation service infrastructure in the energy sector. It should therefore not be a goal in itself but a tool deployed to achieve specific aims. In all cases, utilities should first address a number of questions before they explore the potential of this tool to unlock new services or redefine existing ones:

- What are the capabilities I need to develop before taking the decision of implementing blockchain? For example, is the R&D department properly integrated with the different business areas in the organization?

- Do I have assets that can be successfully represented in a digital format? For example, can I tokenize the MWs per hour in my grid?

- Can I make my operations more efficient by removing intermediaries or middle men? For example, would it be cheaper to enable a payment platform without the involvement of the financial entities?

- Is an unalterable record of the digital assets desirable? For example, would a permanent record of the renewable energy transactions improve transparency and trust in the renewables markets?

- Would it be enough to store only transactional data in the blockchain? For example, would it be sufficient to store exchanges of energy and tokens without personal data from prosumers?

- Do I have a clear direction of where and with what economic benefits blockchain-based applications could be used?

With these questions answered, utilities should design an implementation roadmap of prioritized initiatives that support the strategic objectives and applications.

IMPLEMENTATION:

UTILITIES MUST FOCUS ON ENSURING SCALABILITY, SUPPORTED BY TRUSTFUL PARTNERS

[32] "Dubai Blockchain Strategy", Smart Dubai, presented at Future Blockchain Summit, Dubai, May 2018

Scalability is the biggest challenge for industry-wide applications based on blockchain. Therefore, planning and investing in blockchain proofs of concept is the only reliable way to understand the effectiveness of the technology in a real business scenario. Once the use case is validated, applications should be carefully tested at a higher level through the implementation of pilots that are wide in scope. Utilities should expect and plan for technical challenges, and they should be willing to invest in risk mitigation before reaching the production stage.

GCC governments are following the right path. For instance, the UAE is currently testing more than 20 public and private sector use cases across different industries, including Dubai Water and Electricity Authority's initiative for the charging of electric vehicles. The purpose of these tests is to gain a better understanding of the customer experience, risk mitigation options, unexpected technical challenges, and different delivery models, including the blockchain-as-a-service model [32]. Leveraging the lessons learned from these experiences will be key in enabling the success of future full-scale deployments.

The blockchain ecosystem is especially active within the small and medium enterprise (SME) sphere, with successful use cases emerging from a number of SMEs set up less than two years ago. In such a young industry, finding the right partner to develop and implement blockchain-based applications is both risky and challenging. Therefore, excellence in the design of procurement strategies and tendering processes is vital, and utilities should be willing to explore ways to cover gaps in their business-as-usual procedures and capabilities before embarking on this mission.

ENABLERS

[33] H.E. Omar Bin Sultan Al Olama, UAE Minister of State for Artificial Intelligence, "How Blockchain will lead to a future enabled by intelligence", presented at the Future Blockchain Summit, Dubai, May 2018

[34] "Blockchain Beyond the Hype: A Practical Framework for Business Leaders", World Economic Forum, April 2018

[35] ISO standards catalogue, iso.org

The success of blockchain-based applications in the renewable energy space is directly linked to different enablers that will make this reality possible in the GCC.

On the regulatory side, the GCC is demonstrating its ambition to become a world-class reference. The UAE Blockchain Strategy, launched in October 2016, has three key aims: to achieve efficiency by using blockchain in 50 percent of applicable government services (100 percent for Dubai); to enable, create and activate a blockchain ecosystem for startups and business; and, to spearhead thinking and piloting of cross-border blockchain use cases. The expected benefits include annual savings of 389 million government files, 77 million hours of productivity and 1.6 billion kilometers driven [33].

On the technical side, efforts still need to be made vis-à-vis the international standardization of blockchain. As an example, the World Economic Forum currently recognizes three different types of distributed ledger technologies: permissionless public systems, private permissioned systems and hybrid systems. Each of these three technologies helps to achieve different objectives and each reads and edits the information on the blockchain in a different way [34]. With almost 3,000 companies on the blockchain landscape developing proprietary technology, international standards are necessary to provide traction in this young industry. Here, the UAE again serves as a reference, counting as one of 35 countries participating in the development of the ISO standardization of blockchain and distributed ledger technologies (ISO/TC 307) [35].

Finally, internal enablers such as real-time data and analytics capabilities, decentralized intelligence, innovation and technology strategy, strategic partnerships and open and dynamic corporate cultures are required if GCC utilities are to capture the future value that a technology such us blockchain could unlock in the grid.

Dr. Adham Sleiman
Vice President

Dr. Adham Sleiman is a Vice President with Booz Allen Hamilton and a senior leader within the Digital practice, where he spearheads the firm's Middle East and North Africa Digital Energy & Environment and Enterprise Technology platforms.

Dr. Sleiman specializes in digital transformation spanning the whole lifecycle from strategy development and planning, operating model development (including shared services design) and business process re-engineering, business case development, technology requirements definition, procurement support and/or outsourcing, to implementation oversight and technology operations and service management.

Dr. Sleiman has advised both public- and private-sector clients in the Middle East and Europe in the past 12 years. In doing so, he has worked across a broad range of industry sectors including chemicals, utilities, financial services, telecoms, healthcare, transport, energy and technology. As leader of the Digital Energy platform in the region, Dr. Sleiman supports the technology and smart grid agendas of a large number of MENA utilities.

Dr. Sleiman holds a Ph.D. in communications and signal processing, as well as a master's degree in electrical and electronic engineering, from Imperial College London.

Rafael Mateo
Senior Associate

Rafael Mateo is a Senior Associate with Booz Allen Hamilton and project manager with the firm's Digital Energy & Environment practice.

Rafael has 10 years of experience in strategies consulting. He specializes in designing and executing business strategy for energy and digital players, and has advised public entities, utilities and telecommunication operators across the GCC, Europe and Africa.

Rafael holds a degree in business management and administration and a degree in law, both from Universidad Pontificia Comillas, Madrid. He is co-author of several publications around digital transformation in the energy and telecommunications industries.

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For more than 100 years, Fortune 500 business, government, and military leaders have turned to Booz Allen Hamilton to solve their most complex problems. In the Middle East and North Africa region, we have more than six decades of experience solving the most difficult management and technology problems through a combination of consulting, analytics, digital solutions, engineering, and cyber expertise. With regional MENA offices in Abu Dhabi, Beirut, Cairo, Doha, Dubai and Riyadh, and global headquarters in McLean, Virginia, our firm employs more than 24,600 people and had revenue of $6.17 billion for the 12 months ending March 31, 2018.

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