"Energy in Buildings and Industry and the Energy Institute are delighted to have teamed up to bring you this Continuing Professional Development initiative"

MARK THROWER MANAGING EDITOR

energy institute

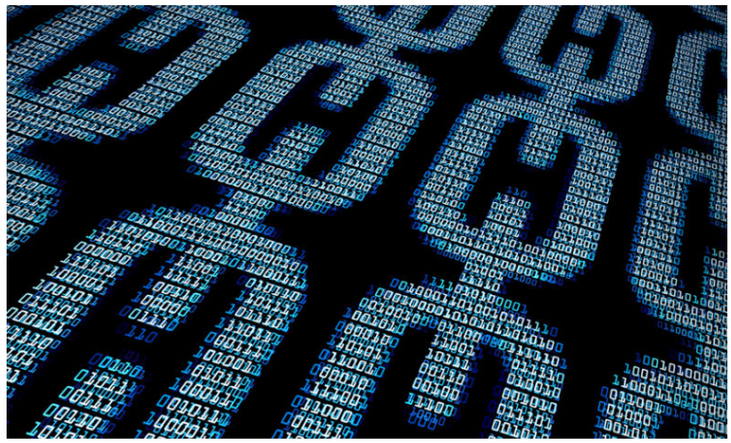
The Blockchain revolution

by Mark Hobbins CEng, FEI

Millions of transactions take place every minute around the world. We transfer money, sign contracts, sell houses and cars. Each time we look to a middleman who we entrust to ensure these transactions happen. For example: a bank guarantees you have sent money; a lawyer will verify a contract or the land registry confirms you bought a house. We also use these middlemen to keep a record of the transactions which also allows us to trust the person or organisation on the other side.

This comes at a cost, or they may make mistakes, or not always competent, or trustworthy, or ledgers used to track these transactions can be tampered with.

So, what if we get rid of the middleman and automate the transaction instead? This is essentially where Blockchain would come in.



Ledger of transactions

Blockchain is a huge ledger of transactions made out of computer code that is stored online. Just like those held by middlemen, the Blockchain ledger can hold a record of different transactions as well. On a Blockchain, transactions are stored in batches called 'blocks' that are linked together in chronological order.

The information in each block is encrypted, time-stamped and given a unique identifier that is known as a hash. Because the hash of one block is determined by the hash of the previous block, the blocks are linked together in a chain forever. In principle, they cannot be changed, edited or deleted. If you need to make a change you have to add another transaction block onto the chain. Leaving behind a tamper-proof record of all past transactions.

But how can you guarantee that the person managing the blockchain does not manipulate the data? Well, while a middleman has full control over the ledger they manage, Blockchain ledgers are not under the control of any one individual or institution. They are a distributed ledger, which means they are held across a whole network of computers. No one person can add to the chain without the approval of every other Blockchain host.

When a new record is added, every participant must verify the input before it is accepted. This is known as the consensus protocol. Once the record has been added to the blockchain, every participant gets a full copy. This is a key benefit. If data is stored across hundreds of locations then there is not a centralised ledger that a hacker can corrupt or change. A corrupt middleman might edit a record, but any record entered onto a Blockchain is verified by all participants, hosted in many locations, encrypted and linked chronological to all other existing records. This makes it very difficult to forge records.

Less vulnerable

Middlemen allow us to trust the transaction that we are conducting. But their records can be vulnerable and potentially tampered with. Blockchain is less vulnerable. It is a decentralised, secure and distributed way to store data and supports claim that it is more reliable than our middlemen. Therefore, Blockchain is a technology that can be used to automate a whole range of transactions from signing contracts to tracking products

to buying energy; and possibly more. So that is a quick overview of Blockchain. Now let us think of applications for this that will impact on the energy sector.

Commodity markets are one area that Blockchain technology might have an impact in the near future. Therefore, the energy will be no different.

Near-term use of blockchain

First, lets introduce smart contracts. Smart contracts are seen as the near-term use of Blockchain and are effectively programmes which are loaded into, and sit alongside traditional transactions utilising a Blockchain. They can automatically execute predefined code when called to. For example, automatically executing the terms of a contract when trigger events occur. Think of a digital confirmation containing embedded if-then statements that could automatically be executed if certain price or volume conditions are met. The impact on transacting cost will be significant.

The important thing about smart contracts is they reside in a decentralised system accessible to anyone that doesn't require any intermediary party. This is seen as a cost-saving measure that increases transparency, improves reporting, and speeds up the transactions. Furthermore, the elimination of inefficient, error-prone and costly back-office processes such as confirmations, actualisation of volumes and numerous forms of reconciliations.

But Blockchain technologies will not simply make the current markets more efficient. They have the potential to disrupt and open up the energy markets in ways people have not yet even considered (again highlighting this is at the start of the maturity curve). Boundaries between asset classes will blur as cash, energy products and other commodities, could all become digital assets trading inter-operably. If more value can be derived by not restricting activity to a single asset class, then that is where the market will go. Blockchain will provide the platform to do that. This may see new entrants to the energy trading environment but also energy traders being able to enter other markets.

Disruption by adoption

Other things to consider are:

- intermediaries such as brokers, exchanges, and clearing houses entire business models could be disrupted by widespread adoption of Blockchain applications;
- the cost and nature of fee-based transacting will be impacted. An obvious advantage with that is a lowering of the entry barriers for new entrants;
- the issue of anonymity and payments will need to be addressed, as will the ultimate link between the digital conveyance of value over the Blockchain and the actual conveyance of value through an acceptable means of payment (i.e. currency);
- the role of regulators and ability for market participants to meet compliance obligations will need to be thoroughly considered and understood. In some cases regulation may ultimately evolve in alignment with new ways of working;
- if certain regulatory hurdles can be overcome (which shall need time and ingenuity), access to markets will open up significantly;
- marketplaces will consolidate, and accessibility will expand, significantly compressing margins at the transactional level;
- trading activity may increasingly involve direct transactions with members of the public, or public consortia;
- the role of the trader itself may disappear as end users transact (organisations and/or individuals, and possibly consortia) directly with suppliers; and
- what is the role of an energy trader in a world where a smart home hub can connect to a global energy market and continuously balance your home's energy use in real time by sourcing electricity or natural gas at market rates from a source supplier?

This is just a hint of the potential disruptive power of widespread adoption of Blockchain technologies.

Smart grids and smart grid technology is thought also to utilise Blockchain in some ways going forward. For now, I shall say only that smart grids are a more complex way of electrical generation, transmission/distribution system; and brings about a greater interconnectivity though. It is seen as a more modern way for the electrical and power markets and is the way we are anticipating most cities going. It requires, not just with the further introduction of renewable energy, fine-tuning and development.

With many Smart Grid Technologies and the Internet of Things, requiring technology that turns things on and off, prioritising and that monitors usage correctly. Blockchain is an ideal candidate to do this. It can authorise access, verify identities, use, durations

energy institute
For details on how to obtain your **Energy Institute CPD Certificate, see entry form and details on page 32**

and undertake automatic reconciliations. It can record and store transactions in permanent records and make data exchanges between distributed gadgets seamless and cost effective. It can also provide the security that will keep a smart city in business and reassure the public on security too.

Individual consumers shall also be actors as things develop more so that now. One such way is, whilst we move toward alternative energy sources. Stored energy can be bought and sold like any other commodities. The key will be to have the security in place to ensure that those transactions are legitimate and permanently recorded and the value of them realised by the consumer. Security will be key for consumer confidence. We are starting to see common themes in the application of Blockchain at this point: security, legitimate, recording, efficient. This is what Blockchain allows to happen.

Furthermore, energy networks are thought to become more robust with the inclusion of Internet of Things and Blockchain platforms, as every node and asset in the smart grid will be helping to keep the grid stable. Blockchain in smart grids ensures the reliability of electricity supply to consumers and the forecasting of major system failures of power systems thereby preventing catastrophic consequences. They can manage electric networks at all levels of energy resource distribution and automation of electricity consumption through the Internet. Decentralising the energy market and the implementation of optimal energy distribution systems by alternative energy expansion are key to our decarbonisation and meeting our future energy needs.

Electric Vehicle charging points are already growing fast, and more are needed if we really are to take combustion engines off the road in the numbers we are looking for to meet targets. Charging points typically operate in a centralised fashion. However, Blockchain could offer decentralisation which would bring us back to individual consumers to install, own and earn revenue by letting other vehicle owners use their charging point in a peer-to-peer fashion.

Role of the utility company

The role of the utility company becomes a facilitator, a provider of charging posts, a creator of a vehicle charging app, of smart Blockchain contracts, of a smooth user experience, of energy metering and charging/billing for energy usage. It is likely that we will see other players enter this market. With a good example being Tesla, as an EV manufacturer that is also installing charging posts. Energy companies are and can participate in valid peer-to-peer energy transactions by using a data platform to bridge the gap between normal payment systems and Blockchain transactions.

We will see that this application cannot be solved only using blockchain technology, nor can it be solved elegantly without blockchain technology.

Blockchain technology exhibits a significant potential in the energy industry, offering a new, tamper-proof mechanisms for authentication, authorisation and multiple data exchanges. While the industry remains rigid in terms of regulation or perhaps slow we should still expect a certain degree of Blockchain-based innovation in the near future, but greater innovations in the medium term.

We already have examples of Blockchain being used in energy trading, smart grids and electric vehicles; but we will see it come into energy management, building automation (not just for exporting and importing energy but load shedding and such if you like), as well as working alongside diagnostic tools for more effective use of our energy assets. Blockchain will become an enabling technology of the future and it is also likely to add some complexity in areas we would probably not want it. Overall though it is a change that is coming.

The questions I would pose to other energy professionals is: with energy storage in our homes and more people turning to electric vehicles, will this be the two-fold market change to allow it to happen at consumer levels? Would Blockchain allow us to become self-organising in our energy use as individual consumers?

It really would be an exciting prospect; and I'm sure with our targets around electric vehicles and decarbonising this could be the step change we need for both to fully be realised.

For details on how to obtain your **Energy Institute CPD Certificate, see entry form and details on page 32**

CPD SERIES 17 | MODULE 06 | NOV/DEC 2019

ENTRY FORM

BLOCKCHAIN TECHNOLOGY

Please mark your answers below by placing a cross in the box. Don't forget that some questions might have more than one correct answer. You may find it helpful to mark the answers in pencil first before filling in the final answers in ink. Once you have completed the answer sheet, return it to the address below. Photocopies are acceptable.

QUESTIONS

1. Having an intermediary for our transactions is required because

- ☐ We do not necessarily trust each other
- ☐ We need to formulise our transactions
- ☐ We need a ledger of our transactions
- ☐ All of the above

2. Each encrypted block is called

- ☐ Mash
- ☐ Sash
- ☐ Tash
- ☐ Hash

3. Each block cannot be changed without the acceptance of the other blocks?

- ☐ True
- ☐ False

4. Smart contracts using Blockchain are already used for

- ☐ Automation of Transactions
- ☐ Hiding transactions from central Government
- ☐ Reducing mistakes
- ☐ Reducing hours traders need to work

5. Blockchain technology will reduce costs in transactions going forward?

- ☐ True
- ☐ False
- ☐ Unknown

6. It is anticipated that current marketplaces will

- ☐ Expand
- ☐ Explode
- ☐ Consolidate
- ☐ Stay the same

7. Blockchain Technology will make smart grids

- ☐ More complicated
- ☐ More secure
- ☐ Slower to develop
- ☐ Make them greener

8. The role of the utility provider shall be as a

- ☐ Regulator
- ☐ Controller of assets
- ☐ Pay Energy Generators
- ☐ Facilitators

9. What areas have we not see Blockchain to date

- ☐ Energy Trading
- ☐ Smart Grids
- ☐ Electric Vehicle Charging
- ☐ Load Shedding

10. Blockchain shall not enable us to have a more decentralised energy market

- ☐ True
- ☐ False

Please complete your details below in block capitals

Name ..... (Mr. Mrs, Ms) .....

Business .....

Business Address .....

.....

.....

..... Post Code .....

email address .....

Tel No. .....

Completed answers should be mailed to:

The Education Department, Energy in Buildings & Industry, P.O. Box 825, GUILDFORD, GU4 8WQ. Or scan and e-mail to editor@eibi.co.uk. All modules will then be supplied to the Energy Institute for marking

Produced in Association with energy institute

CPD fundamentals

THE CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMME

How to obtain a CPD accreditation from the Energy Institute

Energy in Buildings and Industry and the **Energy Institute** are delighted to have teamed up to bring you this **Continuing Professional Development** initiative.

This is the sixth module in the seventeenth series and focuses on **Blockchain Technology**. It is accompanied by a set of multiple-choice questions.

To qualify for a CPD certificate readers must submit at least eight of the ten sets of questions from this series of modules to EiBI for the Energy Institute to mark. Anyone achieving at least eight out of ten correct answers on eight separate articles qualifies for an Energy Institute CPD certificate. This can be obtained, on successful completion of the course and notification by the Energy Institute, **free of charge** for both Energy Institute members and non-members.

The articles, written by a qualified member of the Energy Institute, will appeal to those new to energy management and those with more experience of the subject.

Modules from the past 16 series can be obtained free of charge. Send your request to editor@eibi.co.uk. Alternatively, they can be downloaded from the EiBI website: www.eibi.co.uk

SERIES 16

MAY 2018 - APR 2019

1 BEMS
2 Refrigeration
3 LED Technology
4 District Heating
5 Air Conditioning
6 Behaviour Change
7 Thermal Imaging
8 Solar Thermal
9 Smart Buildings
10 Biomass Boilers

SERIES 17

MAY 2019 - APR 2020

1 Batteries & Storage
2 Energy as a Service
3 Water Management
4 Demand Side Response
5 Drives & Motors
6 Blockchain Technology
7 Compressed Air*
8 Energy Purchasing*
9 Space Heating*
10 Data Centre Management*

** ONLY available to download from the website after publication date*

Terms: in submitting your completed answers you are indicating consent to *EiBI*'s holding and processing the personal data you have provided to us, in accordance with legal bases set out under data protection law. Further to this, *EiBI* will share your details with the Energy Institute (EI) with whom this CPD series is run in contractual partnership. The EI will process your details for the purposes of marking your answers and issuing your CPD certificate. Your details will be kept securely at all times and in a manner complaint with all relevant data protection laws. For full details on the EI's privacy policy please visit www.energyinst.org/privacy.

• To hear more from the EI subscribe to our mailing list: visit https://myprofile.energyinst.org/EmailPreferences/Subscribe