Peer-to-peer transactions in the energy sector

Blockchain – an opportunity for energy producers and consumers?

Whilst blockchain-based data transmission and data storage as such can currently be provided at minimal cost, the verification process leads to very high hardware and energy costs-

The technical potential of blockchain applications is clearly apparent even today: particularly decentralised energy supply relationships as well as the execution and recording of transactions are realistic prospects, so the potential for blockchain technology in the energy sector is promising. Blockchain is a technology that enables so-called "peer-to-peer" transactions. With this type of transaction, every participant in a network can transact directly with every other network participant without involving a third-party intermediary.

The blockchain innovation is that transactions are no longer stored in a central database, but distributed to all participating computers, which store the data locally. The first relevant blockchain application was Bitcoin, a so-called "cryptocurrency". Over recent years, Bitcoin has become the basis for other blockchain applications, most of which are currently being developed in finance. A number of businesses and initiatives have recently been launched that apply the blockchain principle to other industries, amongst them the energy sector. Blockchain applications are generally considered to be a very promising technology but they are still at an early stage of development.

Decentralised structure

Its decentralised structure for the execution of transactions and the storage of data is seen by experts to be the key benefit of blockchain technology. With data being stored in several locations at once the information becomes more difficult to tamper with, whilst being available everywhere. However, the majority of experts also believe that there are alternative solutions capable of ensuring the functioning of a decentralised supply system. The trend to revert to more decentralised forms of supply, e.g. customer self-generation or distributed generation from renewable energy sources, is already being promoted in Germany as it is, with the country managing its transition towards a sustainable energy system (the so-called "energy transition"). Blockchain technology is not a necessary requirement for the operation of such a decentralised model and its associated data flows and transactions. Both transactions and data flows could just as well be recorded in conventional databases: this is a belief shared by most experts we have interviewed.

Blockchain is a technology that enables so-called "peer-to-peer" transactions.

At least judging from the current state of developments, these would be faster and less costly to operate, with the added benefit of being largely already available. While blockchain-based data transmission and data storage as such can currently be provided at minimal cost, the verification process leads to very high hardware and energy costs. The cumulative energy costs of some public blockchains have been driven to immense levels due to the many decentralised transaction verification processes that are carried out simultaneously. It must be mentioned, though, that new applications have been able to achieve great progress in this area.

Is it a more suitable tool?

The answer to the question of whether blockchain technology will be a more suitable tool for the energy sector than conventional databases and solutions will also depend on technological progress. The state of the technical infrastructure, data security, and the scalability of the technology are key aspects here. Implementation of a decentralised energy-transaction and supply system will require technical infrastructure that includes, for example, smart meters for all consumers. Data security must be guaranteed by ensuring that the software is proof against tampering and attacks. The technology must be capable of being deployed on a large scale, with computing processes fast enough to ensure that energy can be supplied and transactions

executed in real time and without any delay. Considering the present state of the technology and the progress that has been made since the first blockchain application was launched, it appears safe to assume that solutions will be found to resolve currently open issues. Experts believe that one particular requirement is that people's awareness of the opportunities provided by blockchain applications must grow in step with the technology's development.

Critics assume that the technology is developing faster than the public's understanding of how to use it responsibly. Whether users' awareness of the technology will grow will also be dependent on the availability of concrete suitable applications for consumers. At present, blockchain is a purely technology-driven development. There are no suitable applications available for customers who wish to actively control and manage their energy supply, nor are there automated software solutions for customers who do not want active control of their energy supply. The first group of end customers require suitable applications they can use without difficulty. These apps must be user-friendly, easy to use, and effective. No such applications have emerged as yet, although individual companies and start-ups are working to develop solutions. Customers who do not wish to actively manage their energy supply, for example because they do not own a smartphone or do not want to spend any time on doing this, require automated software solutions. Blockchain technology will not succeed in the energy sector unless such applications are developed and used on a large scale.

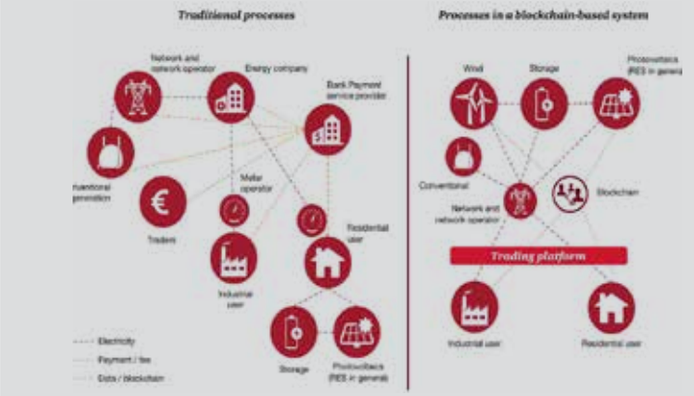
Regulatory challenges posed

If a decentralised transaction model were to be implemented on the basis of blockchain technology, this would probably transform current market roles, with the changes to be reflected in the regulatory regime. All energy consumers would have to manage their own energy balances. Meter operators would no longer be required to collect data themselves, as all transaction data would be recorded automatically on the blockchain.

The current regulatory unbundling provisions require energy companies to separate their network activities (regulated business) from the supply of energy to customers (competitive activity). Customers have the right to freely choose their electricity supplier (or gas supplier) in a liberalised electricity market. In order to ensure that customers can smoothly transfer between suppliers, so-called "balancing groups" were introduced.

This made it possible for each customer to be assigned to a supplier in a simple way. Another significant area of regulation is the so-called "clearing process", which is run to reconcile planned consumption against customers' actual consumption as recorded by their meters. The difference between these is referred to as balancing energy and the costs incurred in relation to this are charged to each electricity supplier according to causation.

Transformation of market structures on introduction of decentralised transaction model



Source: PwC

> **All energy consumers would have to manage their own energy balances.**

Transmission system operator

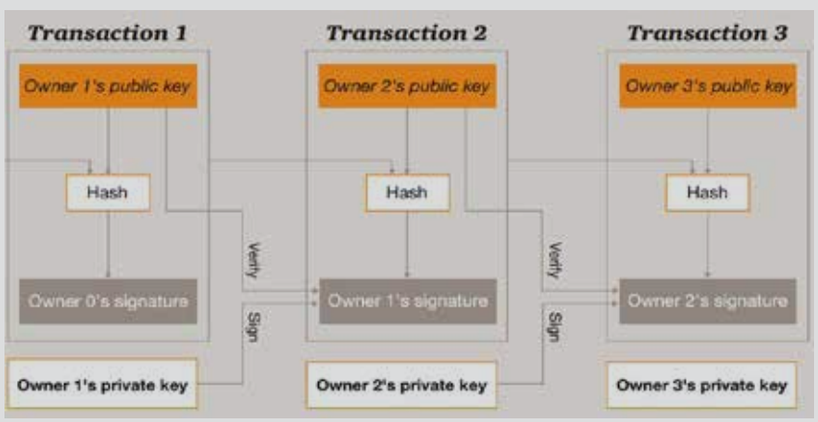
A key prerequisite for the regulatory regime to function properly is that each customer is accounted for as part of a balancing group – by clearly assigning customers to balancing groups and their suppliers to the responsible balancing group managers (which may or may not be the same entity). The meter operators obtain readings of the verified meter data relevant for billing and transportation charging purposes and pass them on to the other players involved: to the relevant electricity supplier for billing purposes and to the relevant transmission system operator (TSO) for clearing and settlement purposes. The TSO collects all data for each balancing group and aggregates it in order to determine the balancing energy costs to be allocated to the balancing group: to the relevant distribution system operator (DSO); to the relevant balancing group manager, who in turn charges the balancing energy (cost-generating) it has been allocated to the suppliers using its balancing group.

The above shows clearly that a simple delivery of electricity entails complex settlement processes across the entire electricity market and that the corresponding meter readings are required for various purposes. In order for the market model to function properly, each customer must be clearly assigned to a balancing group. Balancing group managers are required to provide security in order to ensure that the costs incurred in relation to balancing energy can be recovered.

One major benefit of a blockchain-based transaction model is that all electricity delivered to the networks can be clearly attributed to individual customers in small time units (down to time windows of only a few minutes). This means that all electricity produced and consumed can be settled very precisely at variable prices. The physical electricity as such would continue to flow to the end user directly from the closest generator. A significantly improved database would allow for network operations to be finetuned better at both distribution and transmission levels.

A simplified clearing process would lead to less balancing energy being charged to market participants. Blockchain technology allows for direct contractual relationships to be established between energy consumers and energy producers. *From PwC's "Blockchain – an opportunity for energy producers and consumers?"*

Peer-to-peer transactions



Source: PwC