Flash Analysis

Power, Renewables and Water

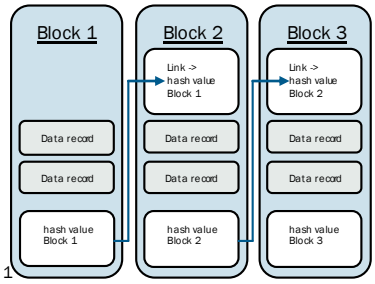
Blockchain in the energy industry

More evolution than revolution

May 2018, Thilo Noormann

Be it electricity trading or system control: blockchain projects in the energy industry are still in the experimental phase. They are one step in the digitalisation of the decentralised energy industry. But they face big challenges.

What is blockchain?



[1]

The term blockchain (originally *block chain*) refers to a database technology that enables transactions directly between contract partners (*peer-to-peer*) through a sequence of encrypted data records (blocks) on decentralised computers (known as *nodes*) without an intermediary. In addition to a time stamp and transaction data, each block contains a cryptological reference (*hash*) to the previous block (chain). Data blocks cannot be subsequently changed without changing the previous one. Only new blocks can be added. Before being executed, transactions are checked by all nodes of the network using uniform algorithms.

Where are blockchain solutions already in use?

Blockchains are used when the focus is the authenticity of data and the logging of changes (e.g. for certificates), for example for

- Digital currencies which are not controlled by central banks (bitcoin, ether),
- Public registers (eGovernment in Estonia, land registers in Ghana) or in
- Financial systems (e.g. EUR 100 million promissory note placement by Daimler AG with LBBW and two savings banks; *Trusted Budget Expenditure Regime* as a transparent development aid financing process between KfW Group, Rwanda and Zambia).

Blockchain solutions in the electricity industry (pilot projects):

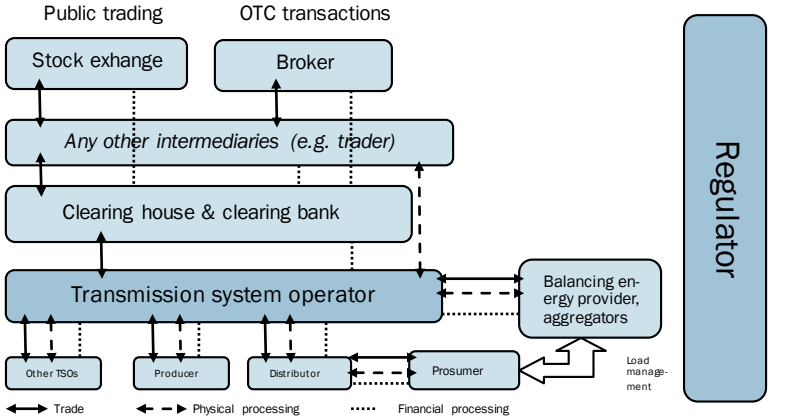
Microgrids:

At local level, electricity producers (prosumers who e.g. generate electricity with solar cells) sell electricity they do not consume themselves to neighbours (private households, businesses). One advantage here is that, in addition to the regional supplier, they have another, possibly cheaper, source of electricity. This infrastructure (including the transmission system) exists in parallel and can also be used. Due to the (very) low number of participants so far, electricity supply and demand can be matched without an intermediary, solely through blockchain solutions. Proven examples of this in practice are the Brooklyn Microgrid (supported by the Siemens venture capital firm next47), the Power Ledger in Perth, Australia, and ME SOLshare in Bangladesh.

[1] See: Daniel Burgwinkel – "Blockchaintechnologie und deren Funktionsweise verstehen" in "Blockchain Technology –Einführung für Business & IT Manager", published by Daniel Burgwinkel, de Gruyter, 2016: simplified description provided here.

Electricity trade:

The supply and service relationships between the actors in electricity trading (producers, EEX, traders, clearing houses, TSOs[2]) are complex (see figure). Accordingly, a large number of data processing and communication systems are operated for trading, for example to carry out the physical and financial processing of electricity deliveries and to generate regulatory reports (BNetzA, REMIT).



See: Michael Merz – "Einsatzpotentiale der Blockchain im Energiehandel" in "Blockchain Technology – Einführung für Business & IT Manager", published by Daniel Burgwinkel, de Gruyter, 2016: simplified description provided here.

Efficiency could be greatly improved if the market players involved agreed on a uniform, blockchain-based trading platform. Controlled by algorithms (also known as *smart contracts* or *chain codes*), the aim is for financial processing and regulatory reporting to also be automatically triggered when a physical electricity supply contract is concluded. However, this requires a willingness to standardise data exchange protocols and make significant IT investments. In the future, this would completely eliminate intermediaries (clearing houses and banks, traders, aggregators) (and cause them to resist these efforts).

Opportunities presented by blockchain solutions:

- Reduction in transaction costs by eliminating intermediaries and interfaces.
- Protection from forgery and better security against cyber attacks because transactions are checked on all nodes.

Challenges and risks of blockchain:

- Additional requirements (*smart meters*, grid access for energy delivery and consumption) for electricity infrastructure and information and communication technology (data centres, fibre optic networks, 5G networks, etc.).
- Trade-off between throughput of transactions per unit of time (*blocktime*) and number of participants/nodes: approx. 100 electricity market transactions per second must be possible with the evolutionary introduction of blockchain solutions in the energy industry, but currently, for example, the bitcoin blockchain only reaches seven transactions per second.
- The energy needed for blockchain transactions is high (approx. 250 kWh of electricity per bitcoin transaction).
- Legislators also need to think about several issues: can algorithms conclude legally binding contracts? How is data privacy guaranteed?

Outlook:

The decentralisation of the European energy industry and the growing number of intraday and balancing energy transactions have led to electricity trading transactions being conducted on a smaller scale (shorter delivery intervals, smaller delivery volumes). This in turn requires transaction costs to be reduced.
Blockchain solutions can help to simplify processes and make intermediaries and interfaces unnecessary. In order to implement them, however, considerable challenges must be overcome. In addition, they are in competition with other solutions, such as transmission system

2 Transmission system operator

operators, or with solutions still under development (e.g. *Internet of Things*, *Distributed Energy Resource Management*) in the field of value chain digitalisation. In some cases, blockchain solutions can also cross-over or enhance these competing solutions.

Conclusion: blockchain is not a *game changer* in the European energy industry.

In the medium term, blockchain solutions will have an evolutionary, not disruptive, impact on the European energy industry. Initially, the aim is to identify process stages that can be completed at lower speeds and with lower data volumes (e.g. RWE is operating a network of charging stations for electric vehicles with integrated billing as a pilot project). It would also be conceivable to implement blockchain solutions in small, isolated systems (e.g. stand-alone solutions) or in developing countries with low rates of electrification.
In complex systems, however, the grid operators (in the sense of a TSO) cannot be replaced without endangering system stability.