Blockchain - What is it, and what does it do for renewables?

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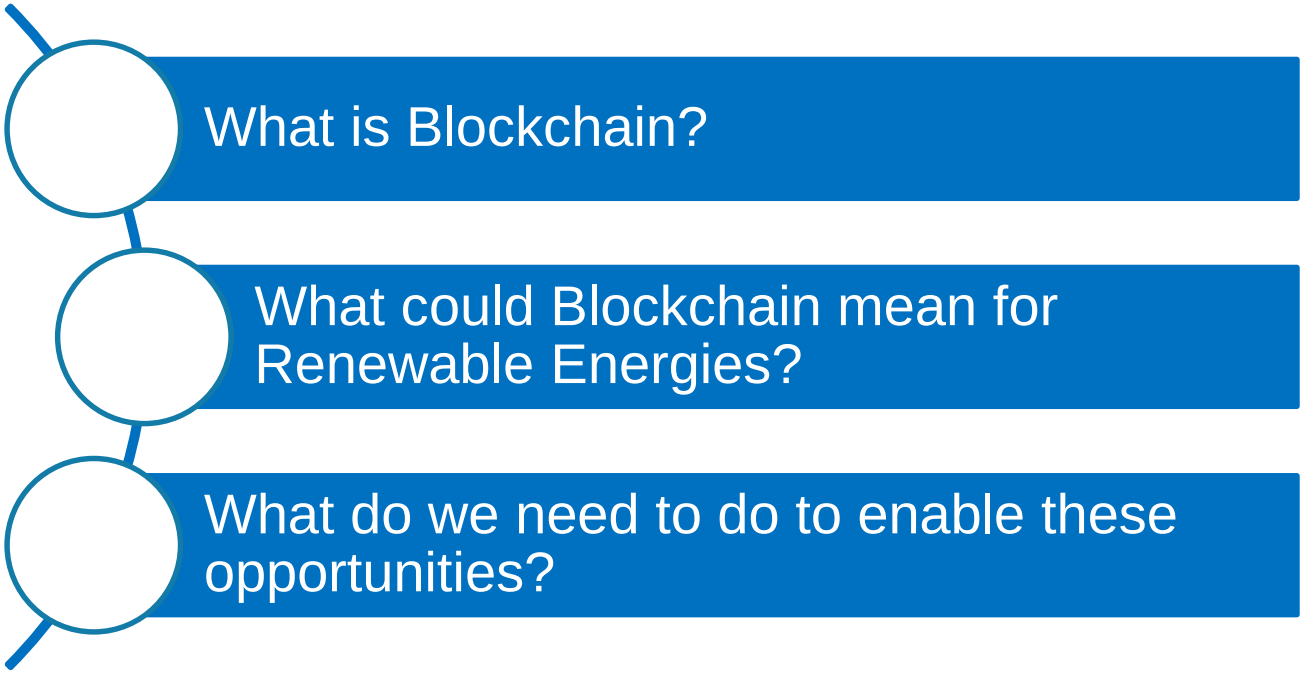
Agenda


What is Blockchain?
What could Blockchain mean for Renewable Energies?
What do we need to do to enable these opportunities?

What is Blockchain?

What does it do?

- » Enables transactions without a consolidator
- » Facilitates peer-to-peer trading
- » Cloud based, distributed & decentralised, traceable transaction recording
- » Public, though private systems can exist

Definition

- » Defined as a public, persistent, transparent, append only ledger
- » Aka ‘bookkeeping on steroids’

How does it work?

- » Trusted authorities verify source data
- » Transactions are proposed
- » Agreed transactions form blocks, a series of which form the chain – the blockchain
- » New transactions are appended as new blocks to the chain which increase chain length, chains remain unbroken
- » Multiple ledgers are held in parallel so alteration is not possible without widespread collusion
- » Chain is secured using cryptography

Transparent, decentralised book keeping, facilitating peer-to-peer transactions

DECENTRALISE, DIGITALISE, DECARBONISE, DEMOCRATISE

Who is working in Blockchain in Energy?

Blockchain software parties

ethereum

Grid Singularity

ELECTRON

energy web FOUNDATION

enerchain

Transmission Grid Operators

nationalgrid

TenneT Taking power further

Traditional Data Managers & equipment suppliers

IBM

SIEMENS

bp

Statoil

Energy companies

Electricity providers

VATTENFALL

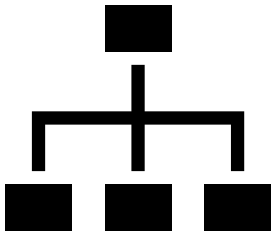
e·on

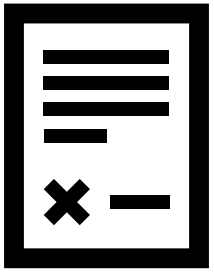
innogy

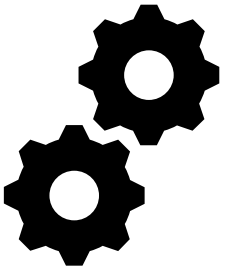
And many, many more, including many start-ups

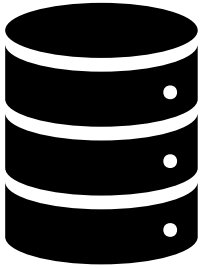
What could Blockchain do for Renewable Energies

- Energy Trading
- Certificate of Origin Trading
- Auxiliary Services
- Data Centre Demand









Energy Trading

Goal

» To be freely able to generate, store and trade energy on a peer-to-peer level

Opportun-ites & enablers

» In a fully deregulated market – freedom of electricity trading between all generators and suppliers

» Removing brokers saves time and money

» Facilitation of easy trades without a broker, increases market opportunity for smaller players, on buy and sell side

» Microgrids are enabling initial trials

Barriers

» Trusted verification agents must be established

» Transmission and distribution systems still need to be paid for, the mechanism must be established

» Transmission and distribution system technical limitations must be respected

» Transmission and distribution system upgrades must be planned, paid for and constructed

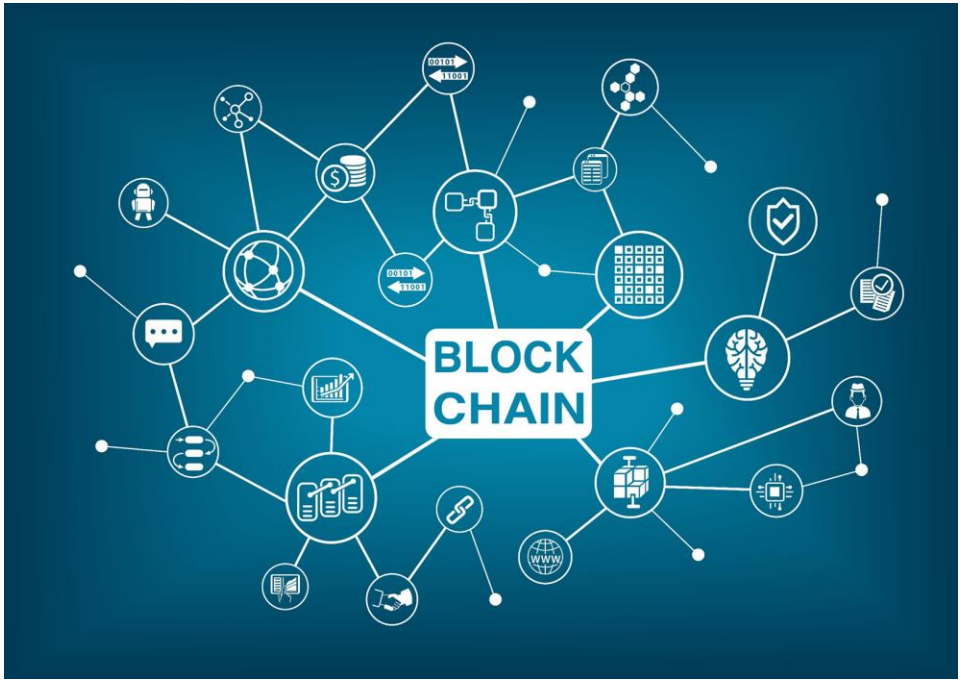
» Using the full public, transparent, opportunity, as opposed to making internal ‘big databases’

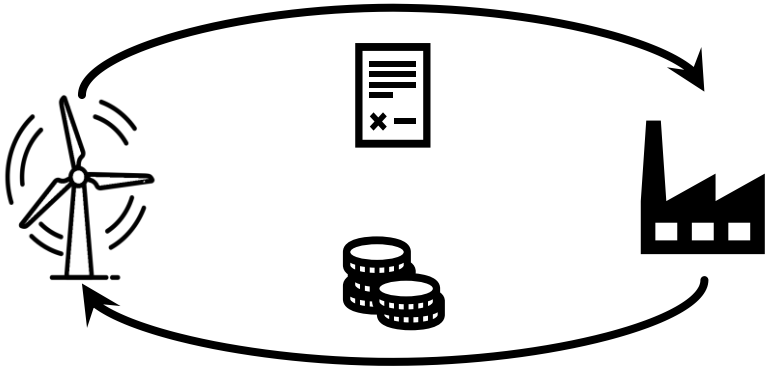
Some Current Examples

BP, Statoil, Shell	Post – transaction management systems
Vattenfall and energy trading firms	Trading platform
Innogy	Public electric vehicle charging

Certificate of Origin Trading

- Renewable Energy Certificates of Origin have become an in-demand, independently tradeable commodity
- A paper commodity, nominally disassociated from physical assets, is readily tradeable
- Current markets rely upon consolidators and intermediaries
- Such a market is a readily accessible, current, opportunity for Blockchain providers





Transparent and Traceable

Auxiliary Services

Services to support the grid, supplied to the grid operator, to ensure instantaneous supply and stability:

» Fast reserve

» Frequency response

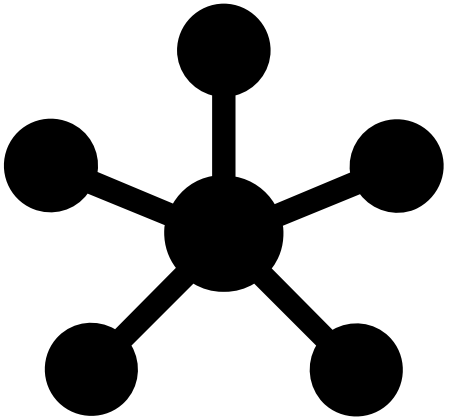
» Demand side response

» Short-term operating reserve

» Constraint management

» Reactive power injection

» Black-start



» Markets are many-to-one

» Grid operator buys from commercial providers

» Trades can be streamlined with Blockchain

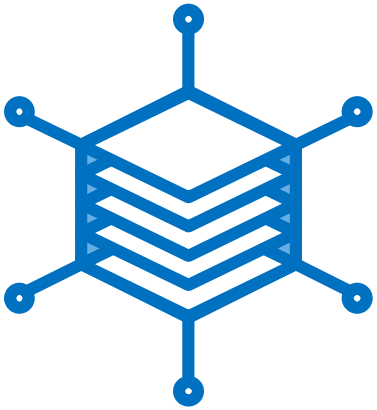
» Allow suppliers to make cooperative trades, sharing upside

» Enables more players to enter the market and offer services

Example – NGET with Electron and Siemens

Data Centre Demand

- The Blockchain system is self-sufficient, and relies upon distributed data centres
- Administering the Blockchain requires large amounts of computational resource
- Data mining at data centres requires lots of energy and produces lots of heat
- Such centres are typically located away from traditional load centres



Example:
Iceland is chosen for data centres due to the cold external climate. Electricity demand is such that datacentre demand may exceed domestic demand. Such requirement could be provided by renewable sources.

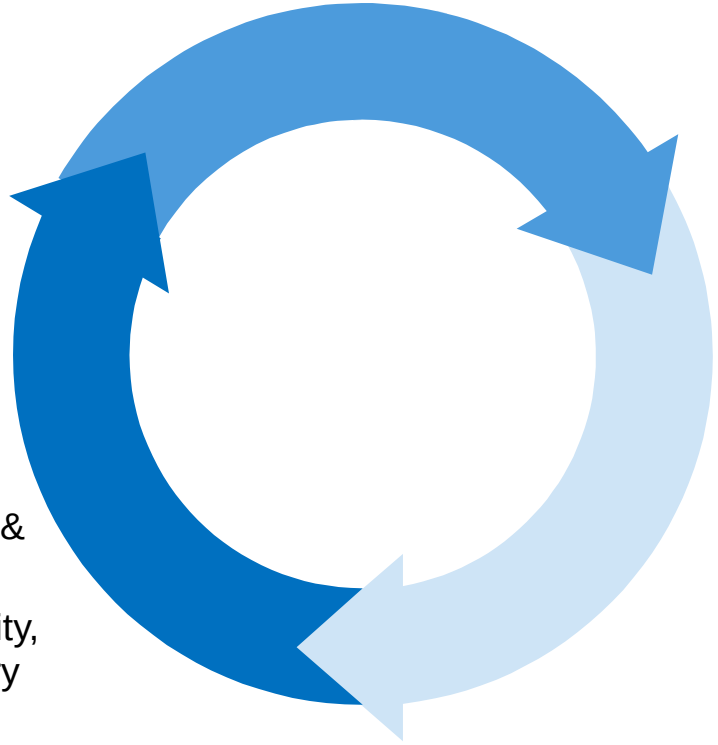
- The electricity demand globally due to data centres and data usage is projected to rise rapidly, to 20% of electricity by 2025.
- Renewables can be used to supply these high localised loads, especially where they are remotely located and co-incident with renewable resource

Where next, and what can we do to facilitate this transition?

1. Regulation

» Regulators need to remove some limitations, and potentially re-structure markets, in order to fully enable the technology

» UK Regulator Ofgem comment on Blockchain & the future of regulation: ‘Should it move away from rules based regulation to outcome based regulation?’



2. Exploration

» Identifying opportunities

» Establishing partnerships

» Undergoing trials

3. Implementation

» Disruptive technology & innovation path

» Fast moving opportunity, in a slow moving industry

About the Authors

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A Project Director and Chartered Engineer, Elaine has spent 23 years in the Electrical Power Industry, the last 15 years in wind farm development through to operations. She is a Power Systems Engineer who moved on to Major Project Development. Elaine is currently a Director at the Renewables Consulting Group, and was previously Head of Offshore Renewables at DNV GL, Project Director for the development of the European Offshore Wind Deployment Centre in Aberdeen, and overall Project Manager for the Edinbane wind farm on the Isle of Skye, as well as Electrical and Grid Connections Manager for multiple projects.

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Max Langtry is a Summer Associate in RCG's London office and a 2nd year Engineering student at Emmanuel College Cambridge. He has strong analytical and problem-solving skills, developed throughout his time as a student at the Newcastle Royal Grammar School. During his time at RCG he has developed software tools in Python to improve the efficiency of data input into wind analysis software, performed supply chain research and income analysis and forecasting. Max received a First Class in his 1st year examinations, with a mark of 88%, and as a result was elected to the Frank Marriott Senior Scholarship by Emmanuel College.

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