BLOCKCHAIN

A POWER AND UTILITIES PERSPECTIVE

EY

Building a better working world

CONTENT

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WHAT IS

BLOCKCHAIN?

THE BLOCKCHAIN IS A NETWORK AND A DATABASE

TRANSACTIONS ARE STORED IN VIRTUAL BLOCKS, WHICH ARE CONNECTED TOGETHER IN A CHAIN, CREATING A COMPLETE HISTORY OF ALL TRANSACTIONS THAT HAVE EVER OCCURRED WITHIN A PARTICULAR NETWORK

Distributed ledger

Back-end database that maintains a shared, distributed ledger

Trust vs. no Trust

Smart contract

Embedding trust rules inside transactions and interactions

Smart wallet

Time-stamped & permanent

Time-stamping, rights and ownership proofs

Peer to peer network

Consensus validation

Resistance to single point of failure of censorship

Immutable

Secure and encrypted

Self-execution of business logic with self-enforcement

Traceable

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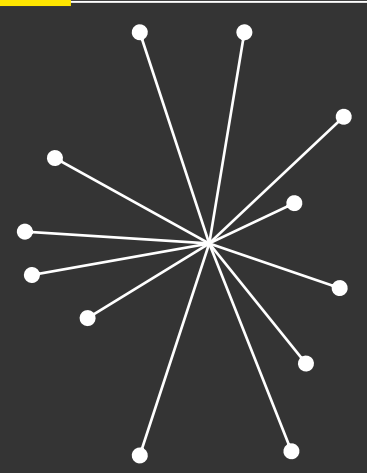
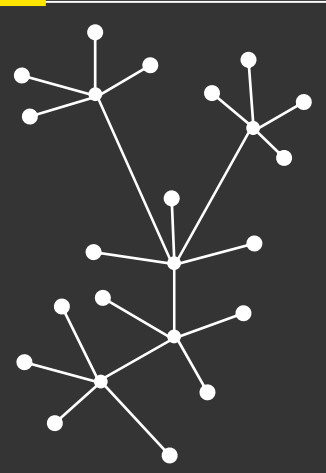
THE NETWORK BECOMES DISTRIBUTED AND ACTS LIKE A HIGHLY SECURE “INTRA” OR “INTER” NET

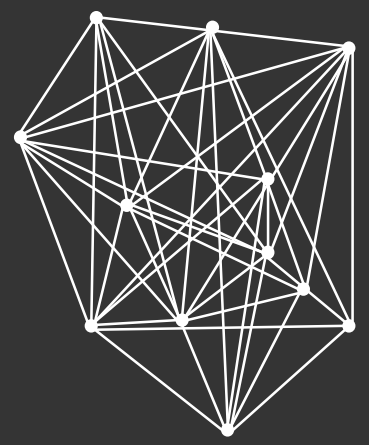
Centralized

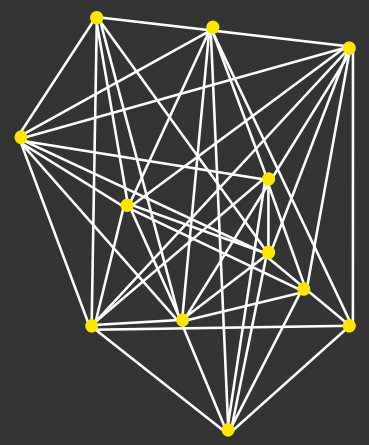


Decentralized



Distributed ledgers





Distributed ledgers can be public or private and vary in their structure and size

Public blockchains

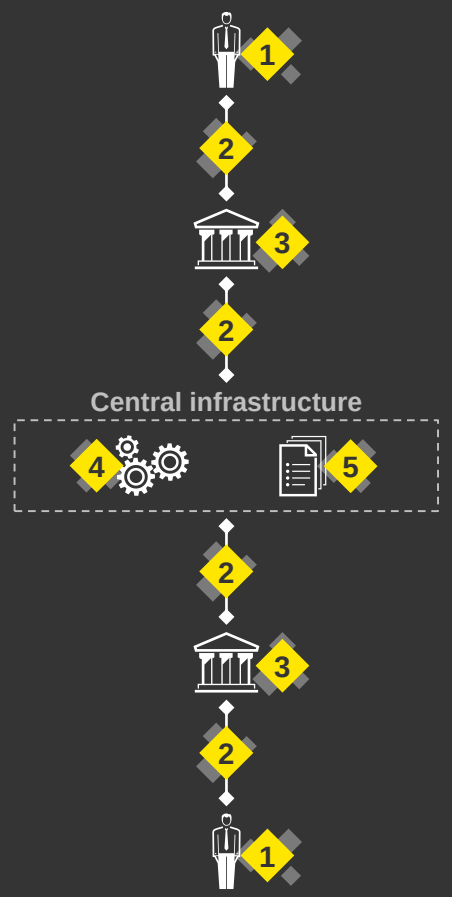
- Users are anonymous
- Each user has a copy of the ledger and participates in confirming transactions independently

Private blockchains

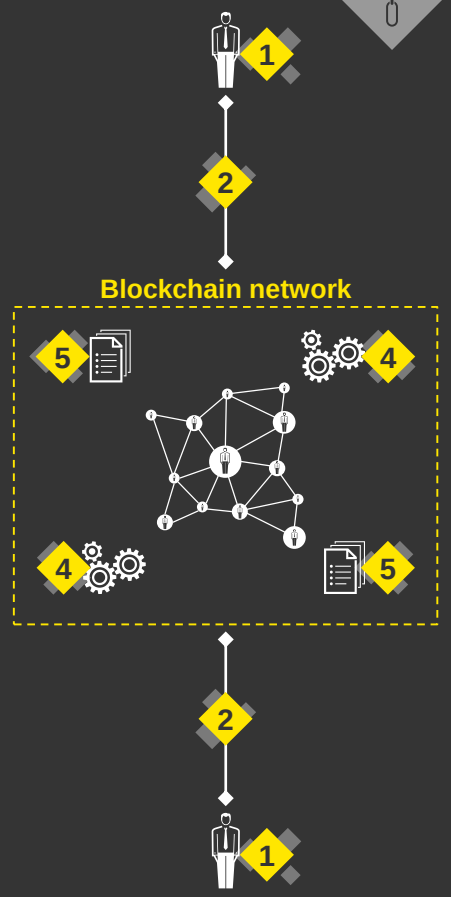
- Users are not anonymous
- Permission is required for users to have a copy of the ledge and participate in confirming transactions

THE CORE CONSTITUENTS REMAIN FAMILIAR BUT THE INSTITUTIONAL ROLE IN TRANSACTION PROCESSING BECOMES REDUNDANT

Traditional



Blockchain



	Purpose	In traditional networks	In blockchain networks
1 Front end	▸ Node or user – the trigger of the transaction	▸ In principle remains the same though IoT likely to increase and diversify the number of machine nodes	
2 Messaging	▸ Technical connectivity with the ledger (database)	▸ Through central infrastructure	▸ Peer-to-peer
3 Institution	▸ Own and administer the transaction	▸ Centrally with cost added to transaction price	▸ Redundant as transaction owner
4 Processing	▸ Execution of agreed actions	▸ Centrally ▸ Batch or per transaction	▸ Distributed (at device) ▸ Pre -programmed
5 Ledger	▸ Auditable repository or database	▸ Central ▸ Closed (one trusted party)	▸ Multiparty ▸ Decentralised ▸ Highest encryption

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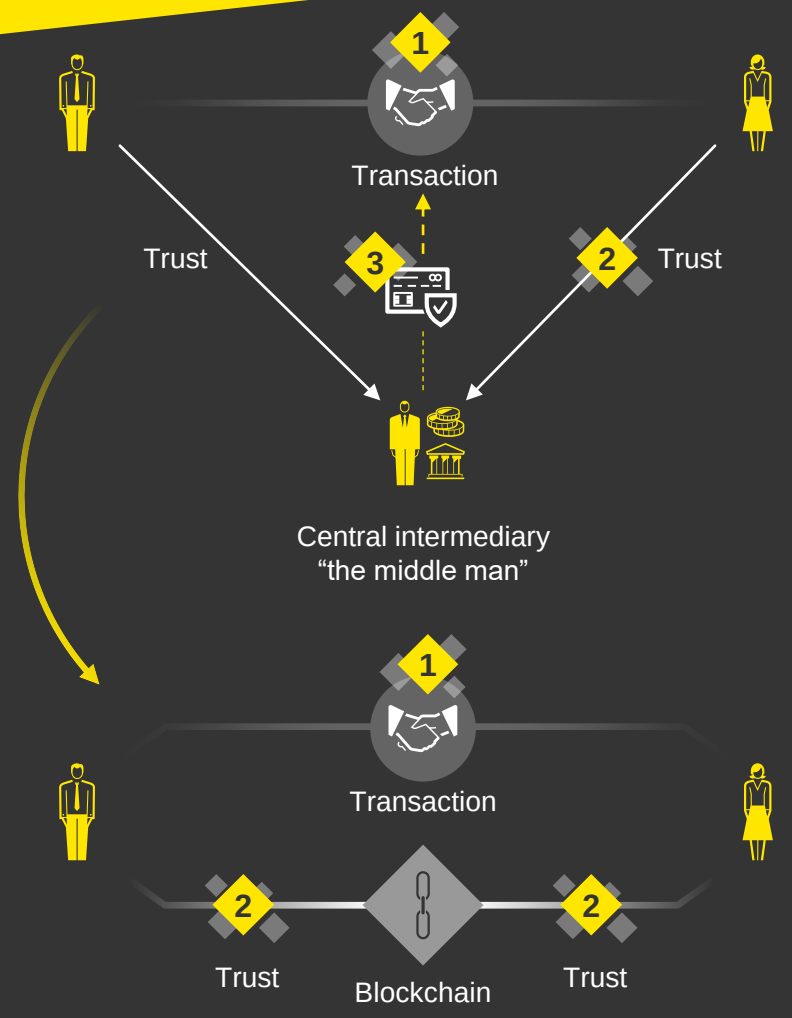
AS A CONSEQUENCE BLOCKCHAIN HAS THE POTENTIAL TO COMPLETELY CHANGE THE WAY WE THINK ABOUT VALUE, SOCIAL INSTITUTIONS AND TRUST



For people seeking social change, blockchain has become more than a technology but rather a strategy to radically redesign the institutions and services we take for granted

1. Two strangers engage in a **transaction**
2. They must implicitly **trust the central intermediary** … endorsed by regulation or the state
3. … to which they exchange value (transaction fee) and privacy

Economists describe this activity as value destructive

This technology holds huge potential to disrupt any industry, creating a world where people get to participate in the value that they create

In the blockchain transactions take place in public eliminating the need for the guarantor of the transaction.

Intermediaries that provide services validating and proving transactions including like lawyers, brokers, and bankers might no longer be necessary.

Needless to say that enforcement and validation of the underlying asset is not automatically addressed by the blockchain.

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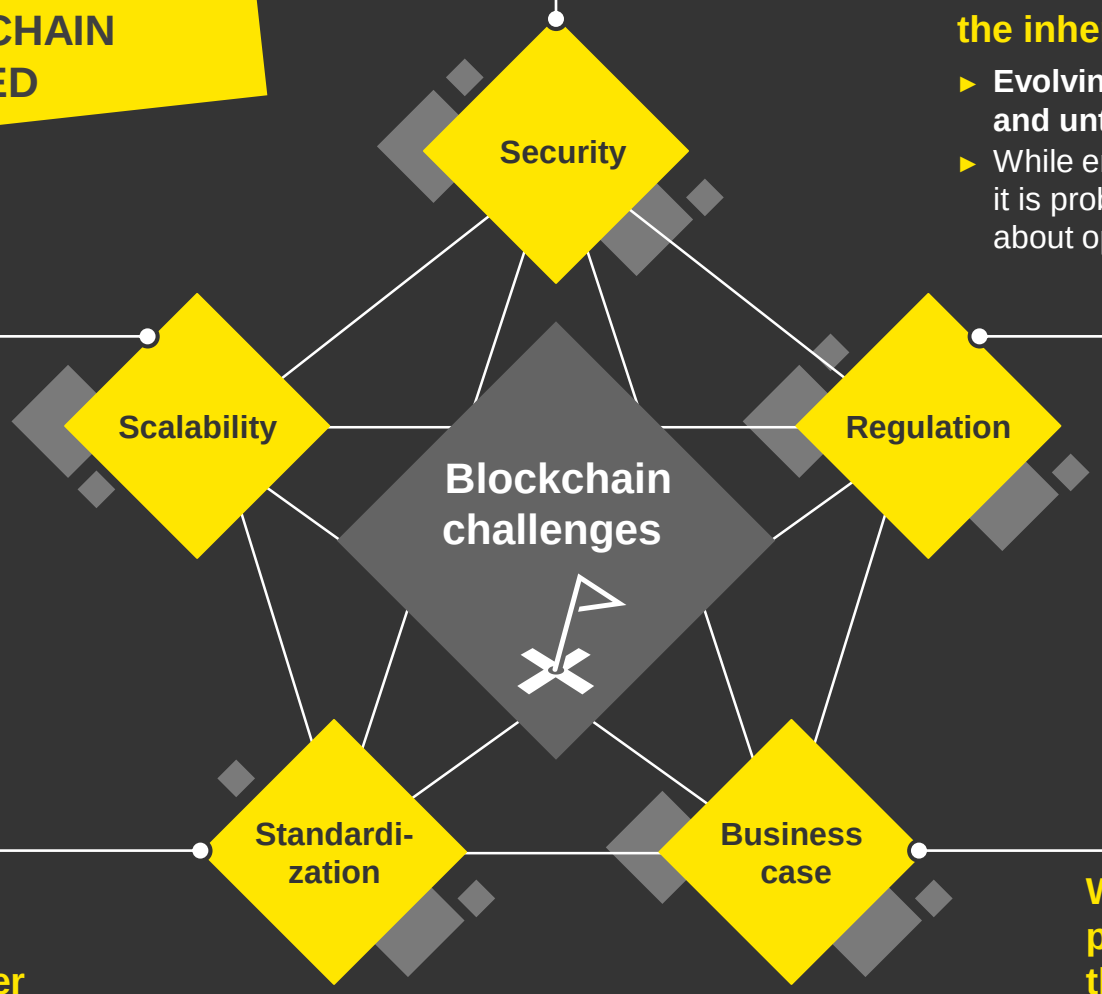
…but:

Blockchains do not magically make the data in them accurate or the people entering the data trustworthy, they merely enable you to audit whether it has been tampered with.

WE HAVE OUTLINED SOME OF THE HURDLES THAT NEED TO BE ADDRESSED BEFORE BLOCKCHAIN CAN BECOME ESTABLISHED



Can the applications be made that match the inherent security of the blockchain

- **Evolving** applications remain **immature and untested**
- While encryption keeps all details from everyone, it is probably possible to deduce more information about operations than parties can today

Public ledgers are already "saturated" with new use cases dependent on exponentially higher volumes

- Slow transactions because of the computational "cost" brings the scalability concern that blockchain will not be able to meet demand

Regulation is written for managing incumbent operators – will it hold back the new architecture?

- A considerable number of aspects of law will need to be reinterpreted or changed through primary legislation
- GDPR will impact the way data can be used

With multiple emerging variants investment will inevitably be held back – the industry needs a winner

- There are a number of technologies under the banner of blockchain. Until one pulls ahead, investment will hold back

What is the use-case that is powerful enough to overcome the legacy hurdle?

- Challenges of legacy infrastructure
- Challenges of technical understanding

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KEY FEATURES OF

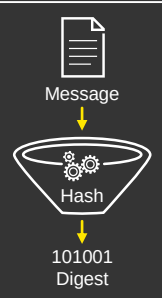
BLOCKCHAIN AS IT STANDS?

AUTHENTICATION THROUGH THE HASH FUNCTION AND PUBLIC-KEY CRYPTOGRAPHY – WHY THE DATA IS SECURE

Hash function

A **hash function** takes an input and produces a fixed-length output

- Ensures that if the information is changed, an entirely different output value is produced
- Practically impossible to invert



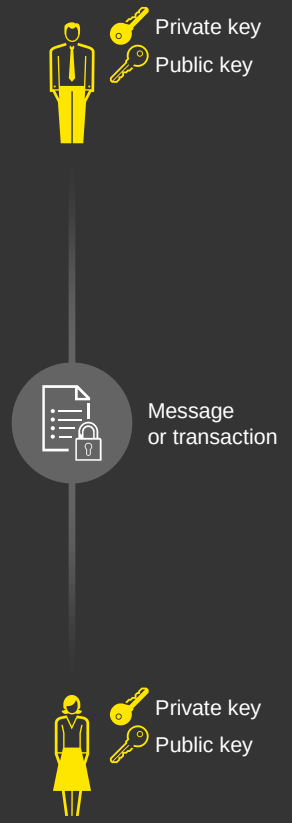
Public-key cryptography

Cryptography is a way to secure information by encrypting it into an unreadable format. Only the person with access to a secret key can decrypt the text into a readable format.

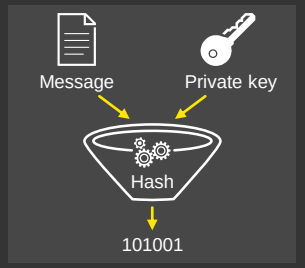
Public-key cryptography is a form of cryptography where there are two keys called a private key and a public key.

- The **private key** is individual
- **It** should be kept secret at all times
- The **public key** is derived from the private key
- **It is broadcast to all recipients**
- It is not possible to derive the private key from the public key

Cryptography Process



1 Digital signature

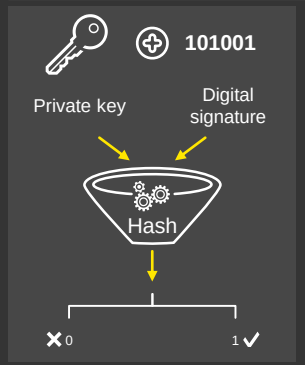


The message/transaction is encrypted with the private key and then hashed, resulting in a digital signature.

2 Transmission

The signer sends the message/transaction request and the digital signature to the receiver.

3 Signature verification



The data encrypted with the private key can only be decrypted with the corresponding public key:

- The receiver also computes another string using the digital signature and the signer's public key
- If this string and the hash match, the digital signature is verified

Authenti-
cation

Traceability

Security

SMART CONTRACTS – WHY DISTRIBUTED TRANSACTIONS ARE ENABLED

The advantage of blockchain-based contracts is that they reduce the amount of human involvement required to create, execute and enforce a contract, thereby lowering its cost while raising the assurance of execution and enforcement processes. By automating a transaction in a fully verifiable framework (the blockchain) the transactions can have legal validity even at high frequency – a key enabler for network balancing

Smart Contracts
are bits of executable code that act only if specific conditions within the blockchain are met

What?
Business rules or terms of agreement form the transaction

How?
Code-based, stored in the blockchain and self-executed

Advan-tages
Guaranteed future execution. Verifiable, signed and encrypted

Challen-ges
Scalability in speed of execution Interoper-ability with legacy systems

Traditional contracts	Smart contracts
1 – 3 Days	Minutes
Manual remittance	Automatic remittance
Escrow necessary	Escrow may not be necessary
Expensive	Fraction of the cost
Physical presence (wet signature)	Virtual presence (digital signature)
Lawyers necessary	Lawyers may not be necessary

WHAT DOES

BLOCKCHAIN MEAN FOR P&U?

A DIFFERENT GENERATION MIX AND TECHNOLOGY WILL HAVE IMPLICATIONS FOR THE FUTURE OF OUR UTILITIES

- Regulatory encouragement of renewables and market reform
- Transition to clean energy future
- Digitalisation of the grid
- Energy usage and demand transformation
- Changing consumer behaviour and expectations

To be successful the industry will need to resolve some fundamental issues

Complex transactions

- As the number of participants increases so does the level of transaction complexity
- Significant increase in the transactions volume

Standards and interoperability

- Seamless interaction between central and distributed resources will require open standards and interoperability

Autonomous response to market signals

- Real time monitoring of network performance, and continuous assessment of supply and demand based on price signals

Empowered Prosumer

- Flexible monitoring and control systems to accommodate different degrees of customer engagement according to individual preferences

Predictability & Reliability

- Renewables are less predictable than traditional grid power sources
- The grid is very sensitive to even small imbalances in supply & demand

Geographic Mismatches

- Ideal locations for solar and wind farms are often far from key demand centres
- Long distance power transmission has a high loss rate

Time Mismatches

- Balancing the supply mix on a real time basis is essential to maximise the energy output and cost effectiveness of the whole system

Trust/Security

- Significant increase in the number of new entrants makes security and trust a critical requirement in the system

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TO DATE THESE ISSUES HAVE RESOLVED INTO A SMALL NUMBER OF (OFTEN INTER-RELATED) USE CASES

Countrywide charging and payments

EV charging optimization away from the meter

Hurdles addressed by blockchain

- Empowered Prosumer
- Autonomous response
- Trust/Security
- Standards and interoperability

Distribution system mgmt.

Establish infrastructure and capabilities to manage meter points and balance supply/demand

Hurdles addressed by blockchain

- Complex transactions
- Geographic Mismatches
- Time Mismatches

Asset and commodity mgmt.

Establish effective real time asset and commodity management and supply chain tracking

Hurdles addressed by blockchain

- Trust/Security

Peer to Peer trading, Market to peer

Facilitate direct consumer trading with the market based on demand/supply balancing

Hurdles addressed by blockchain

- Empowered Prosumer
- Autonomous response
- Trust/Security

Peer to market

Facilitate prosumer access to the market for excess capacity

Hurdles addressed by blockchain

- Empowered Prosumer
- Autonomous response
- Trust/Security

Energy optimization (behind the meter)

Facilitate consumption monitoring, control and optimization in the home

Hurdles addressed by blockchain

- Geographic Mismatches
- Complex transactions
- Standards and interoperability
- Time Mismatches

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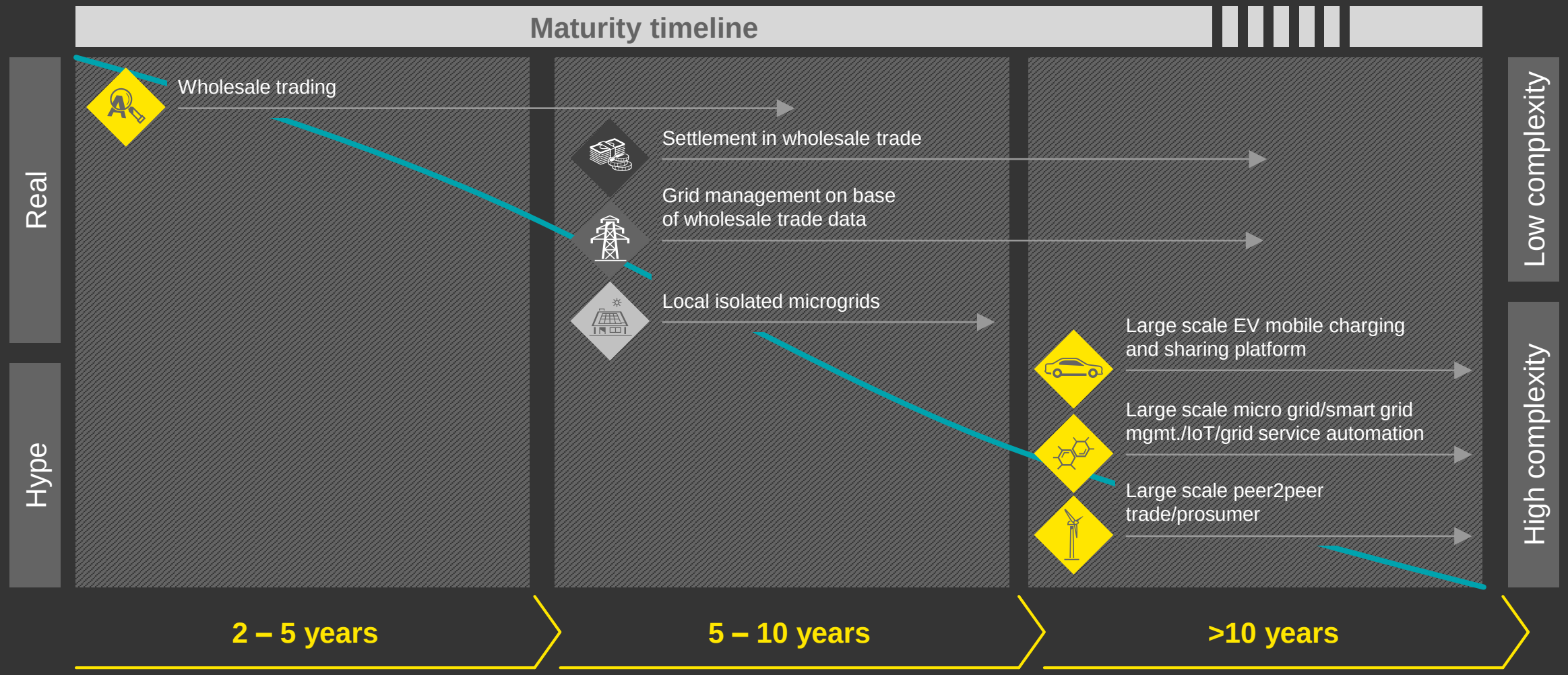
…WITH THE KEY DETERMINANT OF SUCCESS CURRENTLY THE COMPLEXITY OF THE TRANSACTION



Complexity of transaction and counterparty arrangements

LESSONS

LEARNED

AS P&U MARKET ACTORS SIZE UP THE BUSINESS CASE FOR BLOCKCHAIN, THEY MUST ALSO EVALUATE WHICH CURRENT OR FUTURE ENVIRONMENT BLOCKCHAIN IS BEST SUITED TO, AND THEREFORE MOST LIKELY TO MAKE AN UNRIVALLED IMPACT

EY APPLIES A 5 POINT TEST FOR ASSESSING THE FIT OF BLOCKCHAIN FOR A PARTICULAR PROCESS OR ENVIRONMENT

MULTIPLE PARTIES

Blockchains get more secure with more parties in the network, one participant networks are not especially secure

ESTABLISHING TRUST

Blockchains improve trust between participants by having multiple points of verification

TAMPER-PROOF PERMANENT RECORD

Blockchains create permanent records that cannot be edited or deleted

FINITE RESOURCE

Core logic in the system is designed to prevent double counting of assets, record ownership and transfers

IMPROVED TRANSPARENCY

Blockchains are transparent by design – where ownership or control of assets is public and transparent

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A NUMBER OF BLOCKCHAIN PROOF OF CONCEPTS ARE REACHING COMPLETION. IDENTIFYING THE MOST APPROPRIATE USE CASE(S) TO PILOT PRIMARILY MEANS FOCUSING ON THE TECHNOLOGY, ITS POTENTIAL AND THE INSIGHTS TO BE GAINED

THE DECISION OF WHETHER TO SCALE THESE UP IS OFTEN DIFFICULT GIVEN THE LIMITED INFORMATION. IF AND WHEN PRESENTED WITH THESE OPPORTUNITIES P&U LEADERS MUST CONSIDER

TRANSACTION COSTS

Depending on the choice of architecture, a 3rd party is often relied upon to mine a transaction, at a cost. Ensure this is considered early as most test environments do not factor in such cost

COUNTERPARTY ASSUMPTIONS

Most counterparties will not have a full under-standing of the technology and may be reluctant to adopt it. Consider this in your assessment and budget for significant support

CREDIBILITY ASSESSMENTS

Platforms and technologies that can act as the architecture for any use case are fast emerging. While few are proven at scale, remember that most will be willing to invest their knowledge to secure an organization's use-case

BUSINESS AND SYSTEM INTEGRATION

The modular nature of blockchain means that proof of concepts can be quick to build. The development of the user interface is important and accounts for the bulk of the conventional consumer offering and investment, but remains iterative

REGULATORY ENGAGEMENT

There is much value to be gained from working with regulators and trying something new to the benefit of consumers. While understanding can be low, bringing regulators into discussions on governance and market impact is likely to be rewarded

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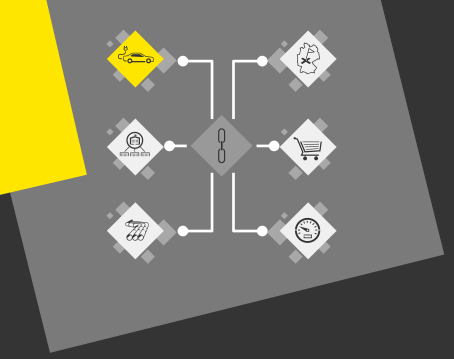
THE USE CASES

IN THE MARKET TODAY

IOT – SMART DEVICES MANAGEMENT

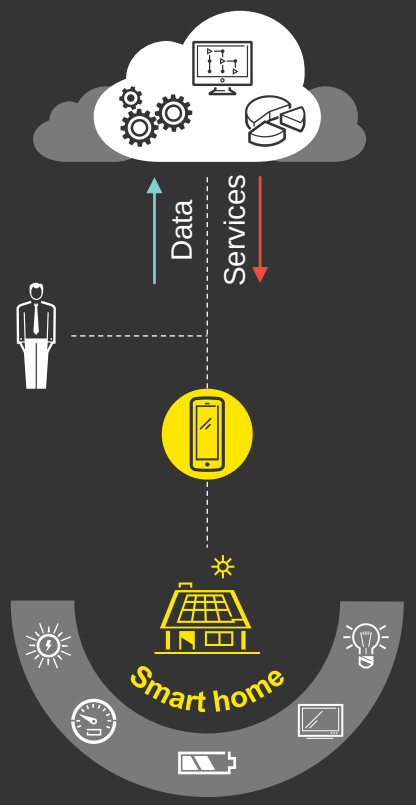


Digital Grid

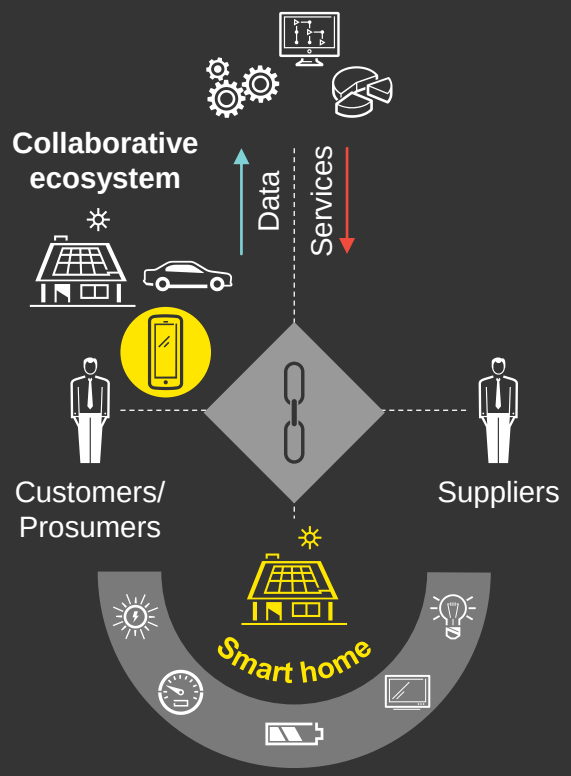
USE CASE: Smart devices management

REFERENCE: BitFury

IoT



IoT & Blockchain



Role of Blockchain?

- Blockchain enables master data management collected through IoT
- IoT and Blockchain implementation enables more efficient grid management and better coordination of multiple smart devices
- Smart devices manage energy usage based on supply and demand

How is Blockchain used?

- Technology converts house hold objects into blockchain nodes allowing increase of smart devices executing smart contracts
- Energy optimisation of smart devices – facilitating efficient energy consumption (on/off peak)

What is the benefit?

- Energy optimisation
- Reducing costs
- Accelerate transactions
- Build trust between parties involved
- Efficient data management and tracking

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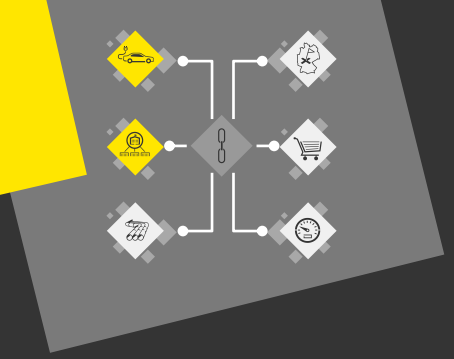
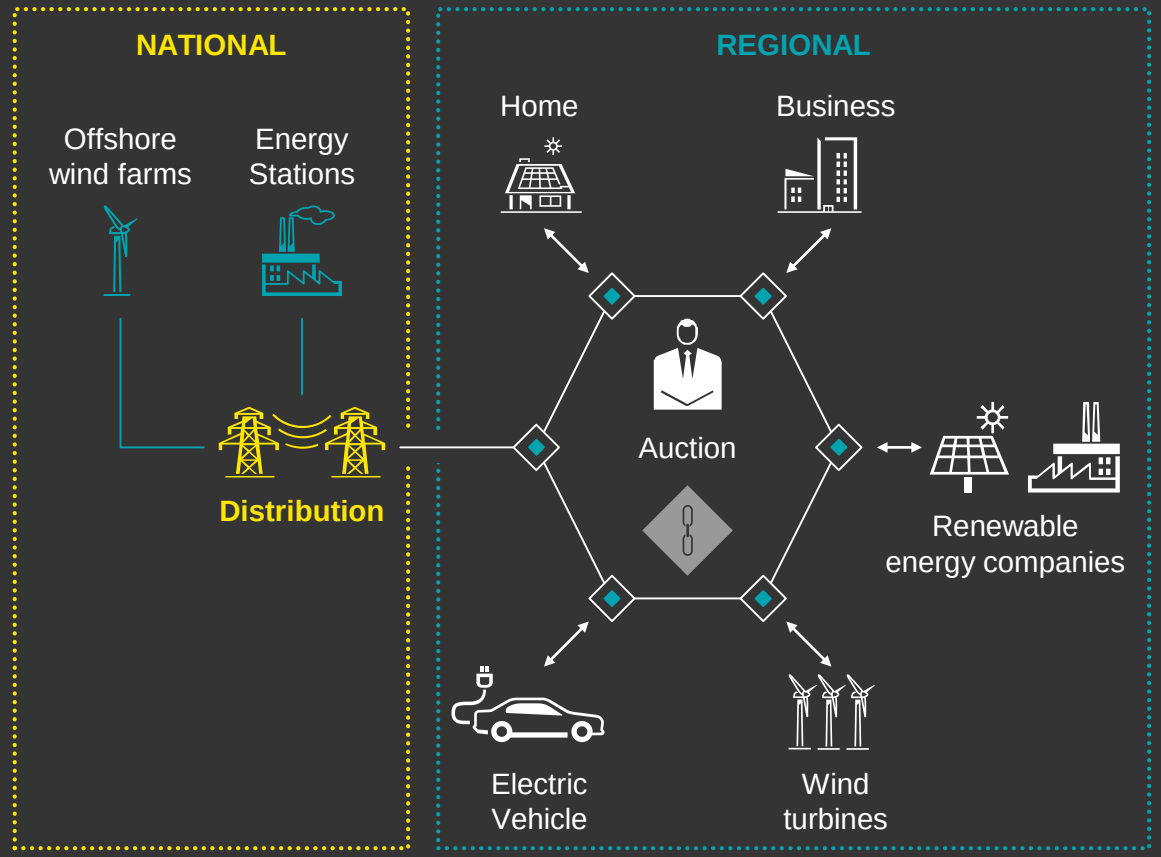
DISTRIBUTION MANAGEMENT & CHARGING (EVS)



Digital Grid

USE CASE: Green energy tracking

REFERENCE: alliander



Role of Blockchain?

- Blockchain is used as a support regional energy distribution and mobile device use
- Demand response and mobility
- Facilitate interaction between supply and demand (on/off peak)

How is Blockchain used?

- Smart-wallets to log users in and charge the vehicle at times that do not contribute to a major peak, in effect shifting the load and reducing the cost per unit
- Ability for users to respond faster to system constraints at acceptable costs

What is the benefit?

- Improved energy flow
- Energy optimisation
- Security
- Real-time market response
- Broader customer base affordability

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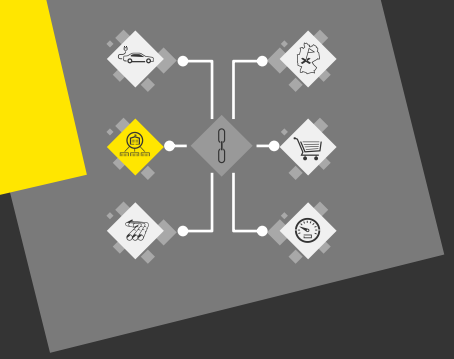
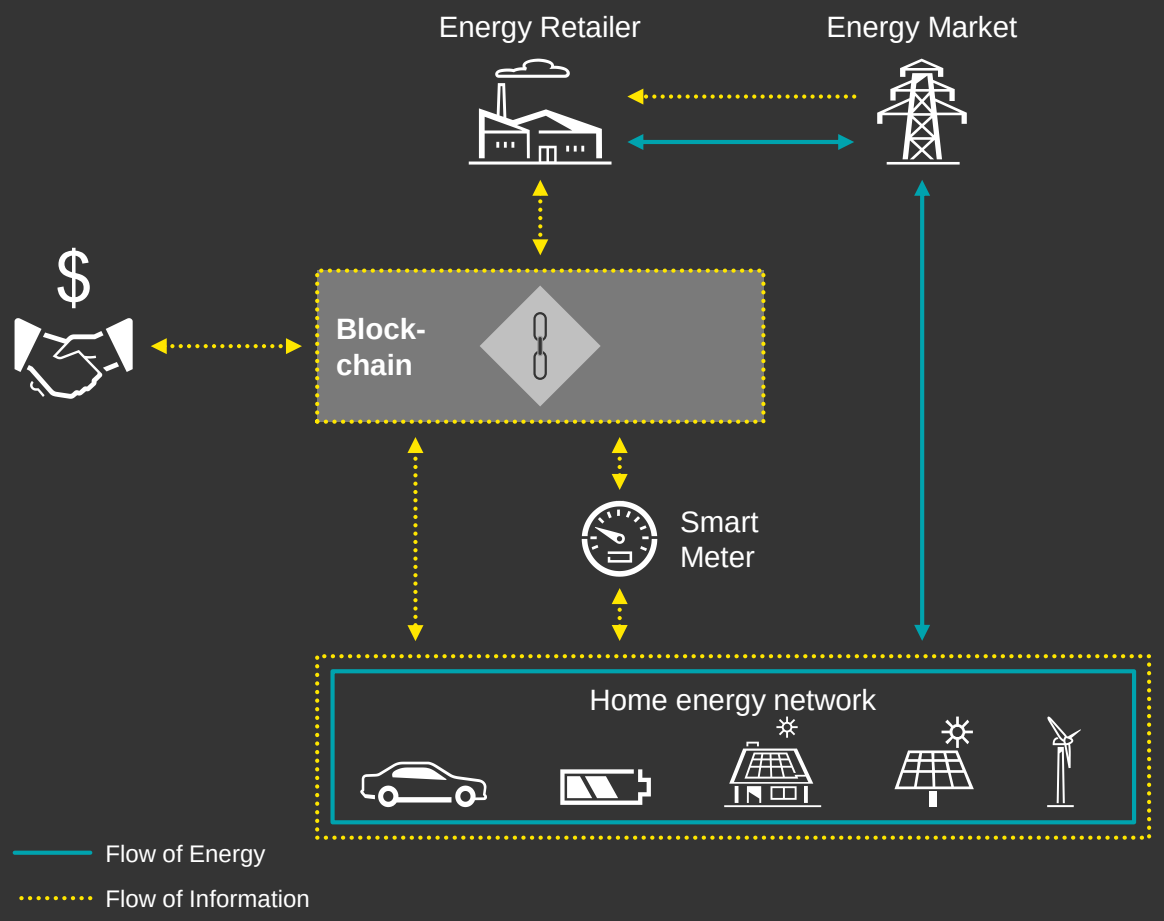
SMART METER DATA AND MANAGEMENT



Digital Grid

USE CASE: Smart meter data management

REFERENCE: ELECTRON



Role of Blockchain?

- Information of supply and demand collected for smart meter is managed on Blockchain platform
- The flow of electricity recorded through smart meter is automatically encoded in to the Blockchain

How is Blockchain used?

- Blockchain acts as supporting technology and manages all data collected through meters
- Facilitate real time consumption monitoring, control and optimization
- Provides ability for consumers to securely share subsets of data to the market

What is the benefit?

- Efficient data management
- Real-time supply and demand
- Customer data value enabled

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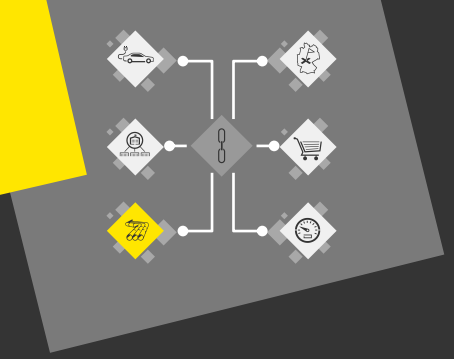
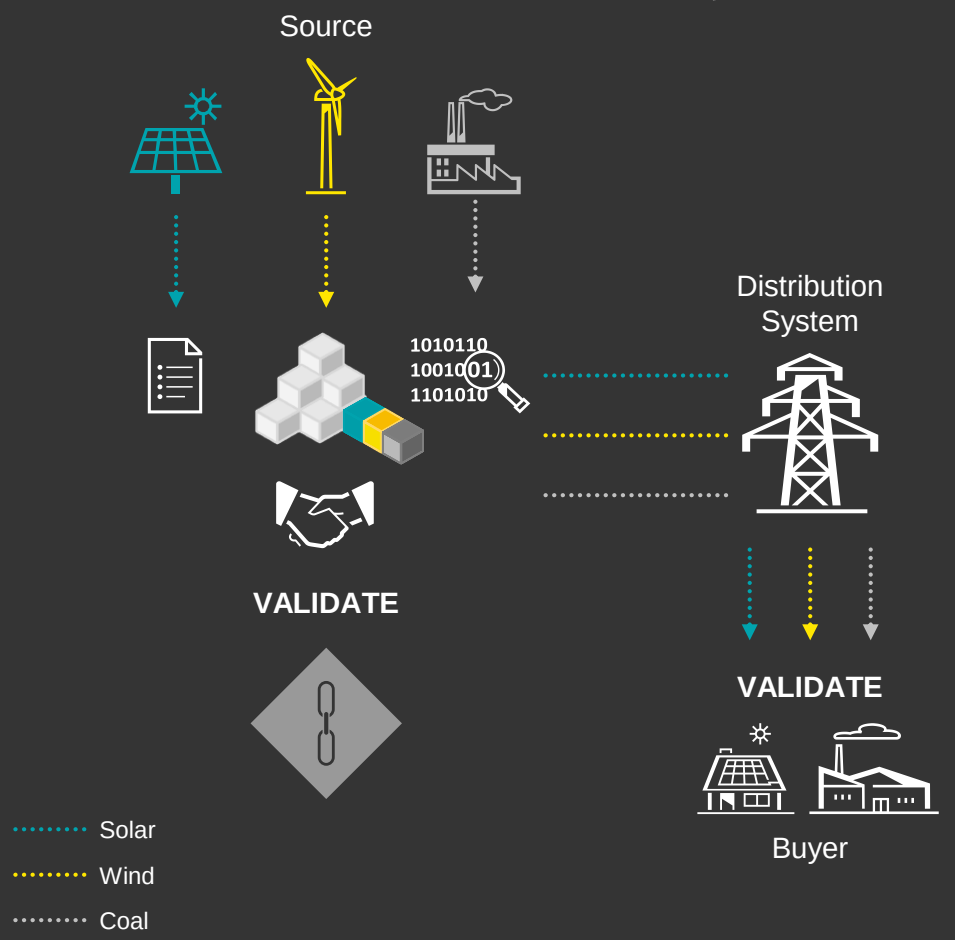
ASSET MANAGEMENT – GREEN ENERGY TRACKING



Digital Grid

USE CASE: Green energy tracking

REFERENCE: GSy



Role of Blockchain?

- Facilitates consumer access to the power markets and enables consumers to track the origin of energy
- Provides the authentication and security to increase the commercial value of the green energy generate

How is Blockchain used?

- Blockchain is used to record exact volume of green commodity or energy used/generated
- This is then matched with the off-take demonstrating that the system has been forced to use green energy
- This improves the commercial value of green energy tariffs

What is the benefit?

- Energy origin tracking and validation
- Trust
- Consumer confidence

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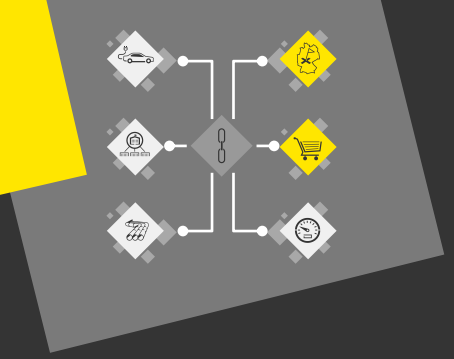
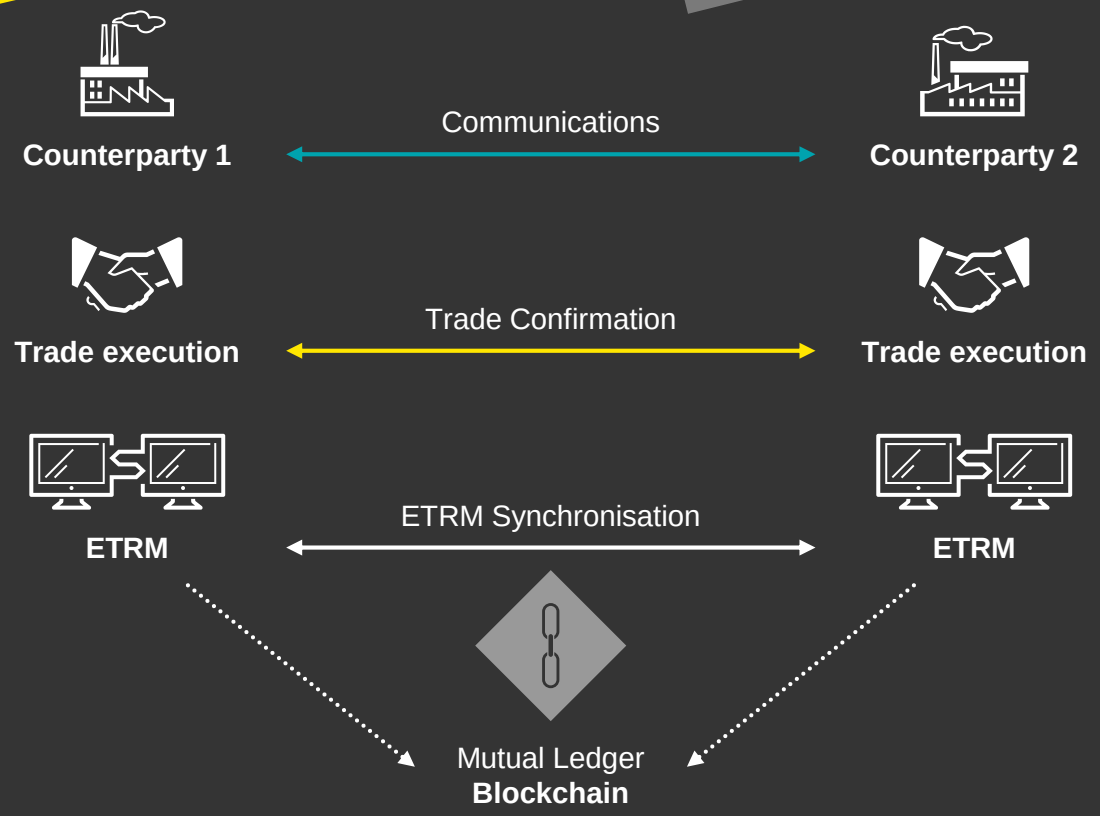
PEER-TO-PEER ENERGY TRADING – PORTFOLIO RECONCILIATION





Trade Confirmation
Trade Execution
Reporting
Auditing

Digital Grid

USE CASE: Peer-to-peer energy trading

REFERENCE: BTL

Role of Blockchain?

- Trading platform uses blockchain to undertake portfolio reconciliation at end of day
- Blockchains auditable and “trust-less” structure eliminates need for validation and improves speed of reconciliation

How is Blockchain used?

- All transactions logged on distributed ledger shared by all parties
- End of day reconciliation takes place using database with single entity errors eliminated through networked database
- Finalised position is logged for regulatory and clearing purposes

What is the benefit?

- Automatic portfolio reconciliation
- More controlled regulatory compliance reduces unknown risks from mismatching trades
- Faster exposure of mismatching trades
- Cost reduction
- Secure by design

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AS DISTANT AS THE 'KILLER' USE CASE APPEARS – ENERGY BUSINESSES STAND TO GAIN FROM UNDERSTANDING AND EXPLORATION

"We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don't let yourself be lulled into inaction."

Bill Gates

UNDERSTAND
The concept and possibilities

If blockchain is the solution, what is the question?

EXPLORE
What does it mean for your business

Where does the solution fit within the value chain?

EXPERIMENT
With the technology

How would this technology affect the value chain?

IMPLEMENT
It in your business

How do these integrate into legacy technology and institutions?

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THE CURRENT

VENDOR LANDSCAPE

WHAT DOES THE BLOCKCHAIN VENDOR LANDSCAPE LOOK ACROSS THE PLATFORMS AND APPLICATIONS

Trade

BTL Group Ltd
- Built from the ground up Interbit is BTL's open, multi-blockchain chain
- Portfolio reconciliation
- Peer-to-peer trading platform

Adjoint Inc.
- Smart contracts building new messaging and consensus protocol
- Institutional Grade Security Features to provide high assurance to parties involved

Blockverify
- Supply chain tracking and traceability

Tallysticks
- Invoice software-Automate the purchase order to invoicing to financing to asset-backed securitisation to payment workflow

Grid management

LO3ENERGY
- Brooklyn microgrid; Local energy network
- Device control to balance the grid

GridSingularity
- Decentralised energy transaction and supply system

Power Ledger
- P2p trading
- Settlement
- Autonomous intelligent

ELECTRON
- Master Data Management for smart meters – demand side response

IoT

BitFury Group
- IoT smart devices
- Supply Chain Management
- Payments Acceleration
- Auditing Assurance & Risk

Filament
- IoT
- Security, scalability, or network stacks

Slock.it
- Security and management of IoT devices
- Smart power plug → renting Hardware

Ledger
- Hardware Oracles – bridging the physical world and the blockchain
- Trust layer between the layers

Source: EY analysis, company reports

QUESTIONS?