Test of Blockchain for settlement of decentralized flexibility

ETIP SNET Central Region Workshop

October 12th

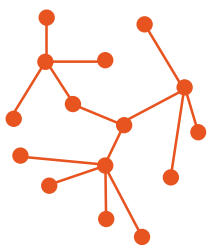
Elia Innovation

What is the blockchain?

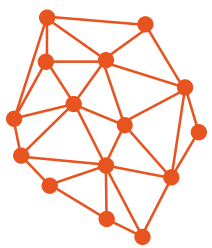
- *Blockchain:*
  - *is an open, secured and distributed record of data*

Centralized

Decentralized



Distributed



  - *could be applied to every cases needing digital transaction or data exchange/ storage from many independent counterparties needing traceability or trust*

  - *Is the base of crypto-currencies*

- **Trustable**
- **Resilient**
- **Transparent**
- **Efficient**
- **Fast**

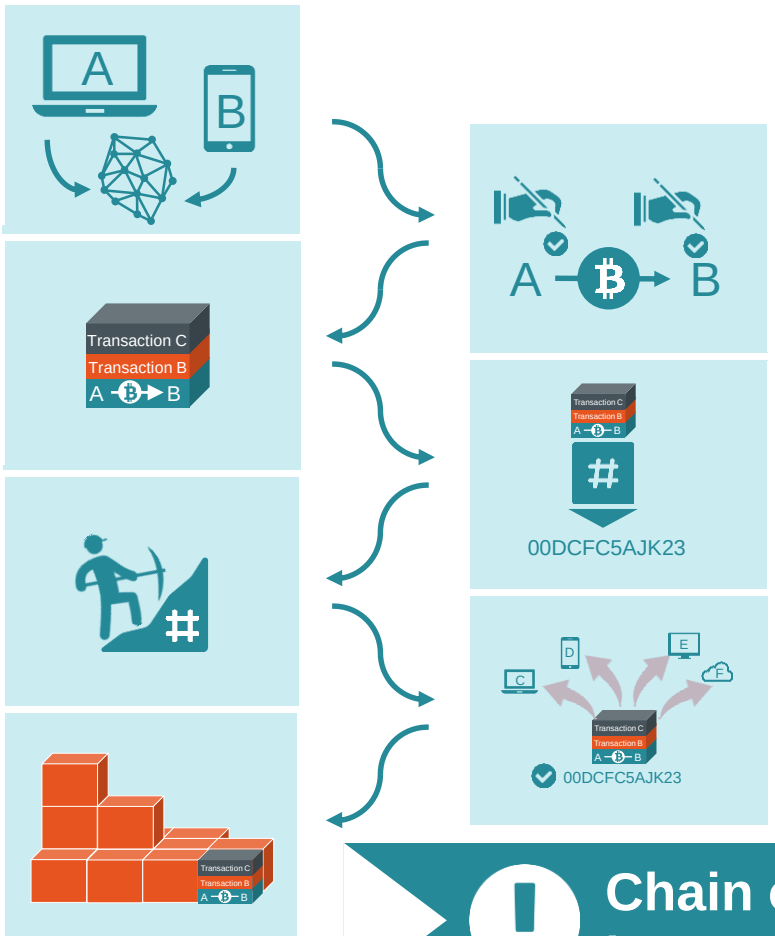
What is the process behind blockchain?

The Users

The Block

The Mining

The Confirmation



The Transaction

The Address

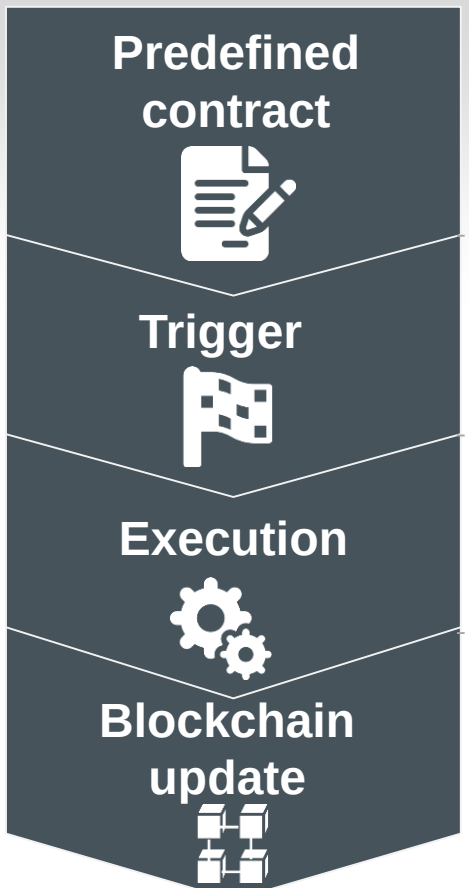
The Broadcasting

Chain of Interrelated blocks immutable replicated in all nodes

SOURCE: BlockchainHub, CoinDesk, Elia

The smart contract is a set of scripts that can run automatically on the blockchain based on specific triggers

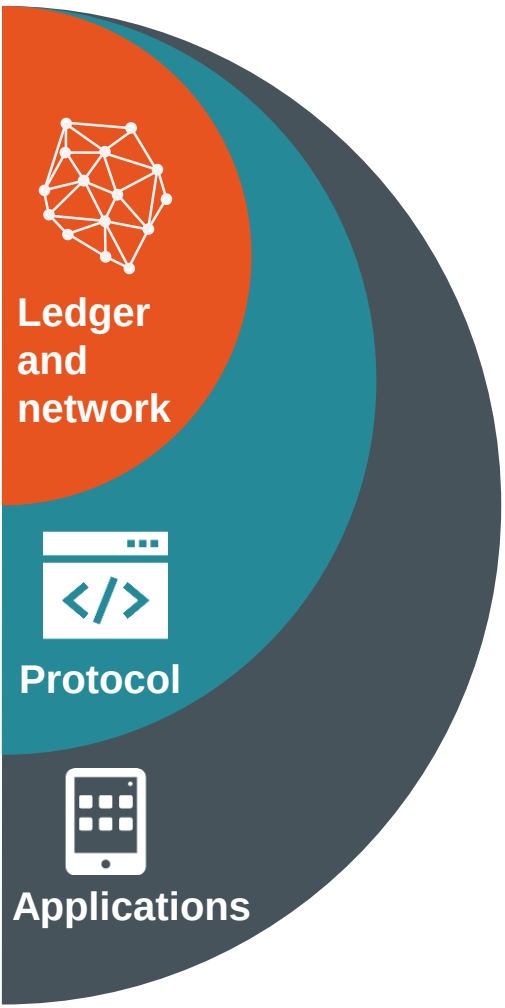
- **Smart contract**: script built under blockchain enabling automatic execution of transactions under certain conditions / triggers
- **Ethereum** is a blockchain specific for designing smart contracts



- Code, compiled and deployed on blockchain
- Trigger on blockchain initiating the run of the smart contract
- Run script related to smart contract on the blockchain with potentially some actions performed off-chain
- Results of the smart contract uploaded on the blockchain

SOURCE: BlockchainHub, CoinDesk, Elia

What are the characteristics of blockchain?



Distributed ledger keeping all records of transactions

- The ledger **type**

Requirements, governance of blockchain processes

- The **consensus**
- **Broadcasting** and **validation**
- **Fee** and **remuneration** scheme
- The **coins**
- The **technical characteristics**…

Applications running on blockchain

- The **smart contracts**
- The **wallet types**
- The **virtual machines** and **node applications**…

User Interface

Different blockchains developed depending on the end-use case

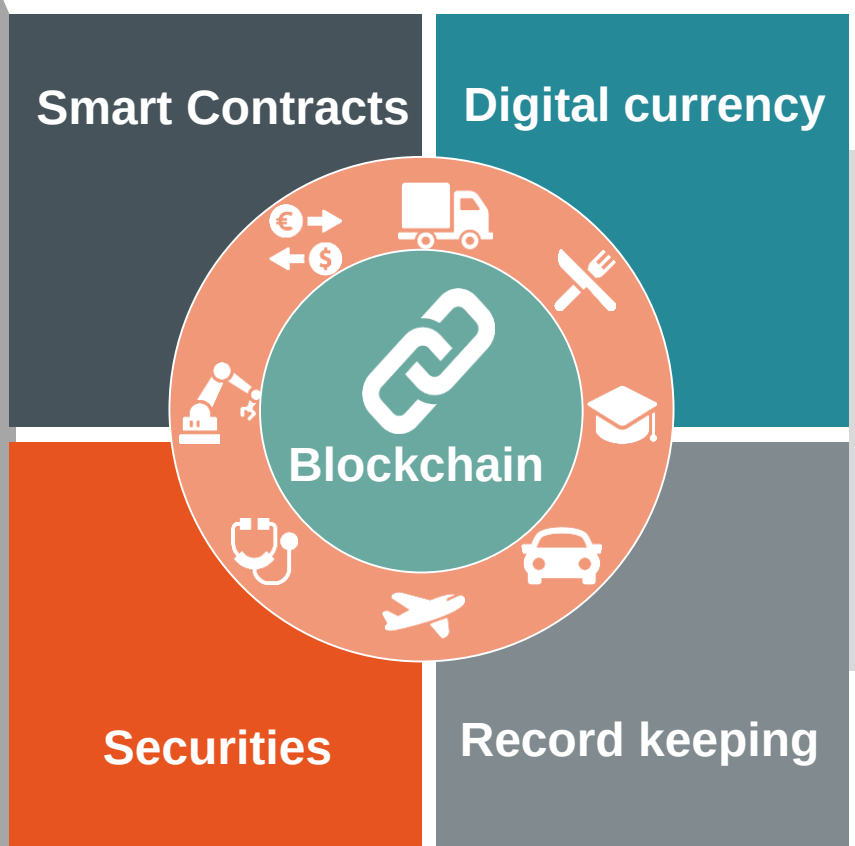
basicattentiontoken
NEO
ethereum
corda
ripple
HYPERLEDGER

SOURCE: BlockchainHub, CoinDesk, Elia

When and for which purposes creating blockchain application?

5 key criteria for blockchain

1. No central authorities
2. Remote independent writers
3. Disintermediation
4. Economic benefit
5. Absence of trust



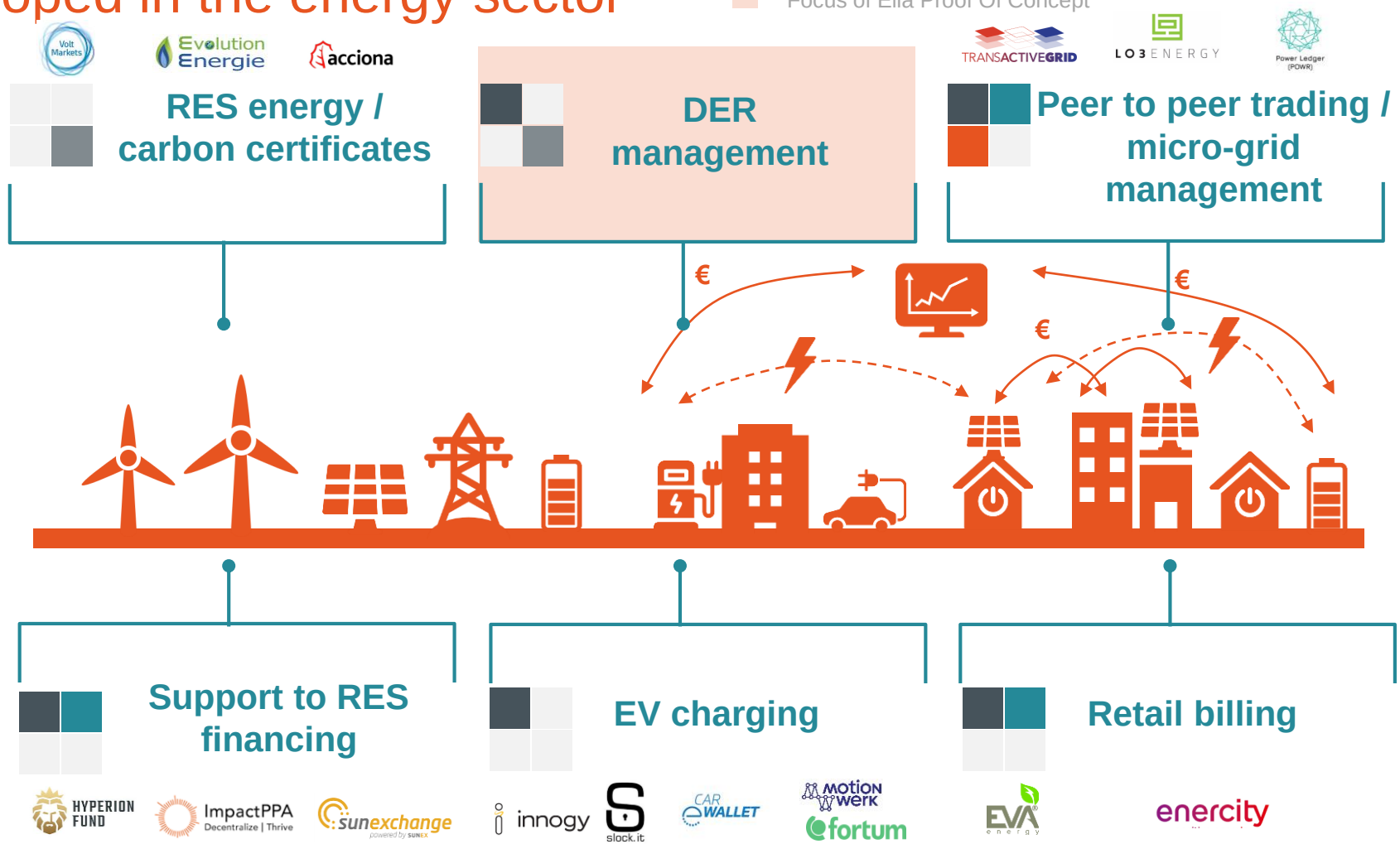
85% of blockchain-named projects are not fully relevant

SOURCE: MultiChain, Gideon Greenspan, McKinsey, Gartner

Multiple applications based on blockchain could be developed in the energy sector

NOT EXHAUSTIVE

Focus of Elia Proof Of Concept



SOURCE: GE, CBInsights, McKinsey, Energati, EWF

Main part of the current pilot project using blockchain in energy are focusing on P2P energy exchange

2016

TRANSACTIVEGRID

- First blockchain in energy transaction in April 2016 in Brooklyn

+122 organizations

- Less than two years later, 122 organizations from energy sector active in blockchain activities

300 mnUSD

- Between Q2 2017 and Q1 2018, over 300mn USD invested in blockchain by energy players

+70 projects

- Currently more than 70 demonstration projects deployed or planned around the world in the electricity industry alone

ener chain · ELECTRON · theSunExchange · slock.it

- Most of the money raised headed toward the transactive energy space, for peer-to-peer transactions

However there are still some challenges for many blockchain use cases in the energy sector

A. Scalability

B. Energy consumption

C. Confidentiality obligation

SOURCE: GreenTechMedia, Press search

Energy Web Foundation, which Elia was among the first affiliates, is developing a blockchain tailor made for energy application

Details in next slide

What

- Global non-profit organization accelerating the adoption of blockchain in the energy sector

Why

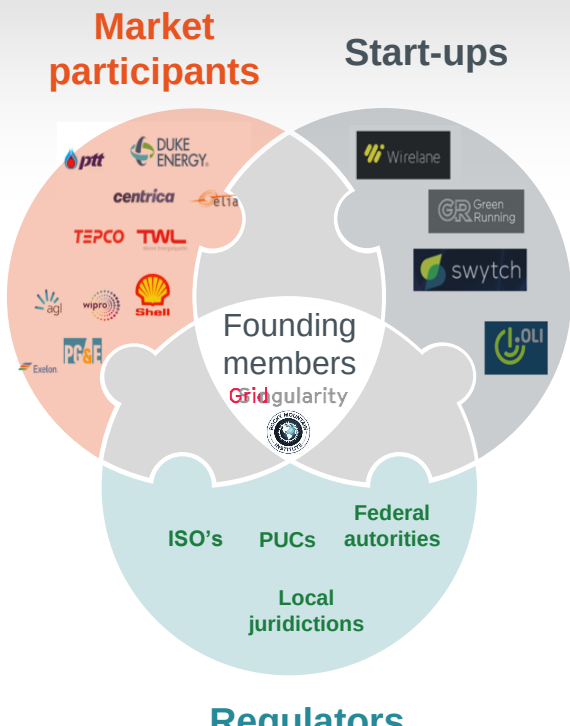
- Develop first open, proof of authority based blockchain operating in the energy sector

How

- Identify, assess, and help bringing to market early **blockchain applications** in the energy sector
- Build an **open source IT infrastructure** upon which these applications can be implemented
- Develop an **ecosystem** of users, application developers, and infrastructure providers
- Educate **regulators, standards bodies** and other critical stakeholders

Status

- In February 2018, **17 mnUSD** raised from a total of 37 affiliates expanding the initial circle of ten founding affiliates (**now more than 50**)
- Test Blockchain, **Tobalaba**, most advanced and only open-source energy industry blockchain platform.
- Focus of 2018: **scaling mechanisms**, and **improving connectedness with physical assets/devices**



SOURCE: GreenTechMedia, EWF, Press search

The Energy Web Blockchain from EWF is tackling the technology limitation for energy applications

A Scalability	Light Client	▪ Light node that does not contain all the repository information enabling EWF blockchain running on small IOT devices
B Energy Consumption	Proof of Authority	▪ Use a proof-of-authority (POA) consensus validation process instead of proof-of-work, dominant protocol today and cause of bitcoin's energy consumption
C Confidentiality obligation	Secret Transaction	▪ Secret transactions that can encrypt smart contracts during validation processes and therefore keep confidential, sensitive information private, yet provide needed transparency to authorized parties, such as regulators

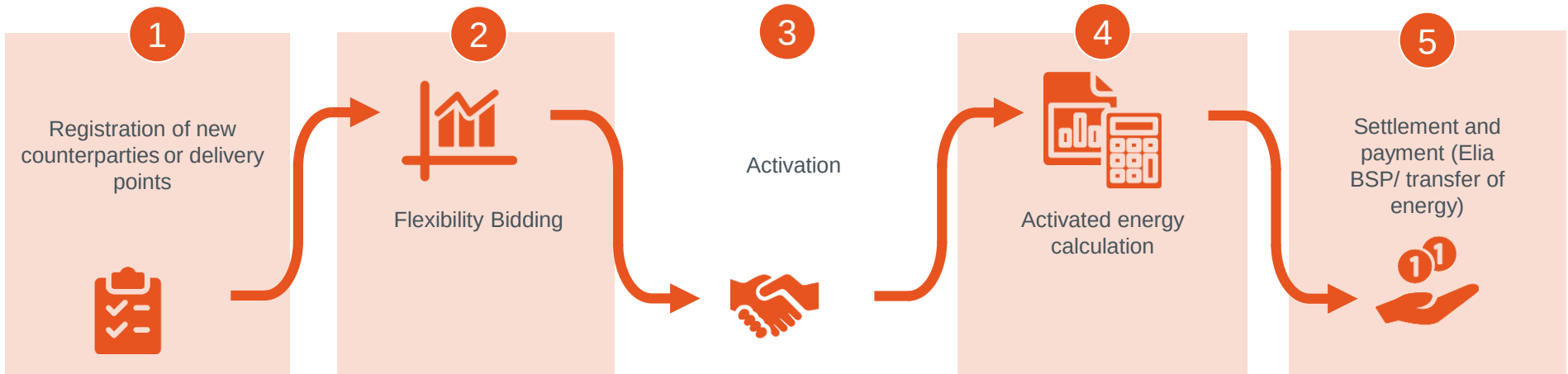
- Open-source test network blockchain Tobalaba launched in November 2017
- Launch in April 2018 of
  - First dApp, EW Origin,
  - Online community, EW Connect
  - Simulation environment for transactive grid operation, D3A

SOURCE: GreenTechMedia, EWF, Press search

First Elia's blockchain POC[1] focuses on registration of players and settlement of flexibility activation from a system operator

In the scope of the POC | Not in the scope of the POC

RESERVE ACTIVATION PROCESS



USE CASES

1	2	3	4	5
▪ Register a supplier and a Balancing Responsibility Party (BRP) and established related contractual links ▪ Metering device validation ▪ Register a Balancing Service Provider (BSP) a Delivery Point (DP) and a System Operator (SO) ▪ Test the BSP activation ▪ Establish contractual links (BSP/ SO and BSP/DP)	▪ Offer flexibility to the SO	▪ Activate flexibility resources ▪ Activate notification to BRP and BSP	▪ Calculate energy delivered for activated DP ▪ Perform activation control ▪ Dispute management ▪ Validation of metering data ▪ Transfer of energy	▪ Financial compensation between SO and BSP using on-chain transaction

SOURCE: Elia Strategy & Innovation

1 Proof Of Concept

The POC consortium is a mix of partners pooling energy business and blockchain technology expertize to support Elia

SettleMint

- Settlemint is a **European leader in blockchain technology**. Its aim is to bridge the gap between businesses' capabilities and their desire to use blockchain to innovate in a rapidly changing world.

- Develop the blockchain application leveraging their proprietary middleware

energy web FOUNDATION

elia

Actility

- Actility is a unique technology company that provides **IoT infrastructure solutions** and intelligent smart energy solutions. It is also a leading player in the flexibility market, involved in **grid-balancing services** in several countries.

- Translate Elia use cases into blockchain development requirements and develop user interface

SOURCE: Actility, Settlemint

During this POC Elia wants to assess different hypotheses about blockchain and build understanding of smart contract development

Learning goals

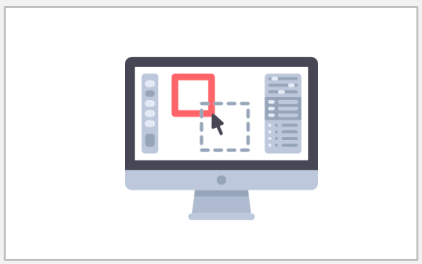
A **Business interest**

B **Technology understanding**

Block-chain intrinsic benefits

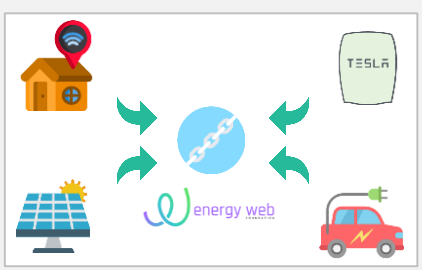
2	**Remote indepen-dent writers**	▪ Use of Smart contract can allow better data quality, notably by putting in place metering device certification logic ▪ Blockchain application can lean SO operations and unlock management of same flexibility by multiple SO's
3	**Disinter-mediation**	▪ Registration and settlement data could be performed end to end using blockchain and smart contract including an automated settlement and on-chain transaction
4	**Economic benefit**	▪ Administrative cost using the SM^2 on BC^1 can be reduced (registration, settlement and money transfer, using current workload estimate)[3]
5	**Absence of trust**	▪ Blockchain and smart contract can prevent from wrong bidding verify automatically credit line for imbalance payment ▪ EWF blockchain can ensure confidentiality

Key deliverable of the POC



- **Interface for the management of flexibility means**
  - Login
  - Bidding interface for BSP
  - Flex management interface for system operators: Similar interface than BidLadder (flex available, price per quarter…)
  - Settlement functionality: energy activated by DP and status of remuneration….

- **Smart contract on EWF blockchain:**
  - BSP contract
  - DP contract
  - Bidding
  - Automated settlement and transaction
  - Logic on and off-chain



- **Connection of flexibility point to the EWF blockchain:**
  - Pool of assets connected to the EWF blockchain and identified by a smart contract
  - Automated metering data upload (on or off-chain)

3 months POC , first results expected by end 2018

We currently have defined the functional requirements and are starting implementation of related smart contracts

Use of blockchain

- Smart Contract for flexible management of **contractual links**
- Smart Contract to develop **tailored characteristic**: base line calculation…
- Blockchain for **management of confidentiality**
- Blockchain for **escrow management**
- Blockchain for **traceability** of metering keys
- Blockchain for **immutability** of data to avoid dispute
- Smart Contract for **multiple SO's** management of the same flexibility

Challenges

- Need of a **trust party data manager**
- Need of neutral entity empowered to **distribute private and public key** to valid metering devices
- **Management of confidentiality data** while benefiting of blockchain security: bid ownership, disputes, list of delivery point, bid history, settlements, penalties…

Current learnings and next steps

Lessons learned during business requirements set-up

Description	Characteristic assessed
Immutability of smart contract as a potential issue in case of new market evolution (products, rules…)	
Still a **need** of a **trusted 3rd party** for metering device validation or management of contest of metered data	
Smart contract enabling **acceleration of dispute management** and build trust by managing escrow	
Smart contract enabling **escrow management** but rules to be defined to avoid new entry barriers	
Blockchain facilitating management of flexibility from **multiple SO's**, especially in case of new small players (e.g. micro-grid manager)	
Use of **secret store** or encryption is mandatory to ensure confidentiality of flexibility owner data	

Next steps

The functional requirements needs now to be translated in smart contract deployed on the EWF test blockchain and tested with real data:

- **Fix the on-chain / off-chain actions**
- **Develop the smart contracts**
- **Develop interface**
- **Assess performance and perform real activation end to end**

SOURCE: Elia Strategy & Innovation

Independent writers | Disintermediation | Cost benefit | Absence of trust

If this project is successful, next project could involve other system operators to test cross-SO management of flexibility in real conditions

Expected outcome is that blockchain and smart contracts enable cross-SO management of same felxibility and accelerate settlement process

Next test could be cross-SO management of flexibility in real conditions

A **Business interest**

B **Technology understanding**

- Using smart contracts is **accelerating the settlement** (less than few minutes) limiting end to end activation process and reducing the administrative cost
- Right selection of off-chain actions (base line calculation, validation method…) are enabling **sufficient flexibility** while guaranteeing the confidentiality of data (DP[1] list, DP[1] contractual links, dispute, metering data…)
- Blockchain and smart contracts are enabling the management from **multiple SO's** for the same DP[1]
- Blockchain smart contracts are **easy to develop**

- Test **DSO – TSO** application for real flexibility cross-management including congestion and frequency control
- Include **automated activation by** linking directly physical devices to the blockchain
- Develop and test proper **key management** for metering devices certification

SOURCE: Elia Strategy & Innovation

1 Delivery Point

If you want more info about innovation @ Elia, check out the Elia Innovation Website: innovation.elia.be/

Thank You!

Any questions?

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