SRBE IBVE
Société Royale Belge Koninklijke Belgische
des Electriciens Vereniging der Elektrotechnici

Webinar
"Balancing the future grid"

Thursday 20/05/2021

The webinar will start in a few minutes

Introduction

Introduction

KBVE/SRBE Webinar

3 sessions:

- ✓ April 22th 2021
- ✓ May 20th 2021
- ✓ June 10th 2021

Format:

- ✓ Introduction
- ✓ Speaker 1
- ✓ Speaker 2
- ✓ Q&A (chat)

Introduction

Gunther Schoovaerts

Head of Assets & Grid Architecture Electricity
"Balancing the grid – Challenges ahead"

Thomas Smets

Lead Business Consultants
"Blockchain based energy and flexibility markets"

Introduction

Prof. Erik Delarue   Dr. Kenneth Bruninx

KU LEUVEN

Energy Systems Integration & Modeling

Lien Van Schepdael

FLEXCITY *by* **VEOLIA**

Technical account manager

What we do

Forward-looking network solutions (multi-utility)

Archieving climate targets
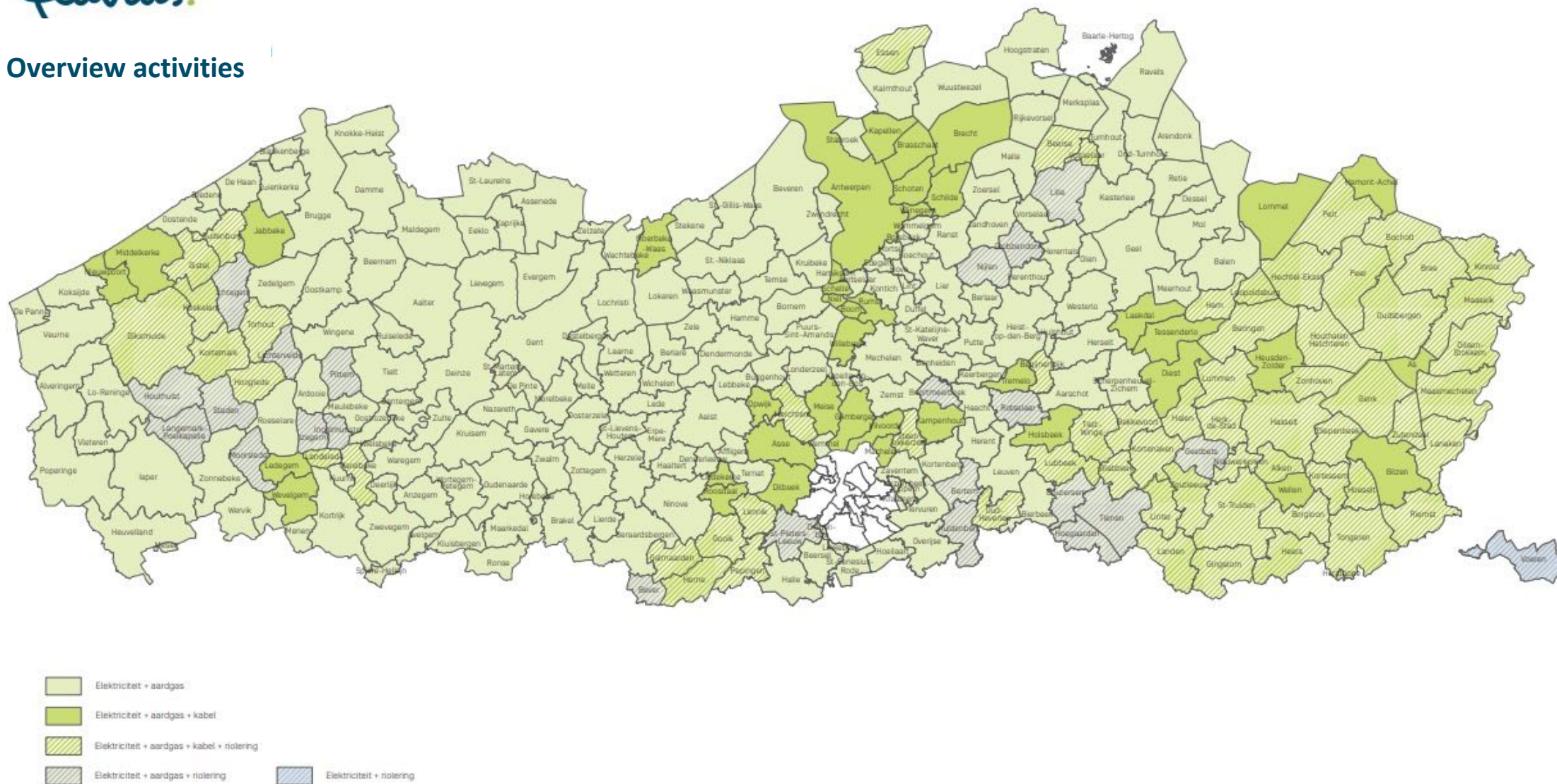
Fighting energy poverty

Managing energy data

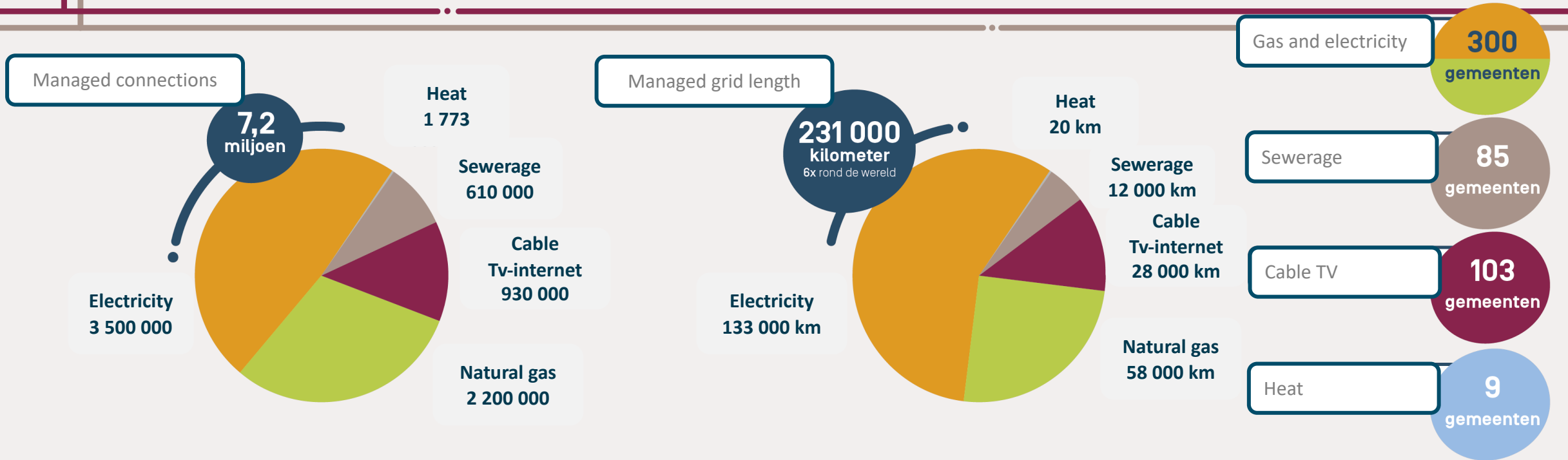fluvius.

Key figures Fluvius (dec. 2019)

Lighting points
1,2 miljoen

Revenue*
€3,5 miljard

Employees
5 400

Investments*
€859 miljoen

€15,2 miljard
Balance sheet total

* Figures Economic Group 2019, incl. DSO's

Elektriciteit + aardgas

Elektriciteit + aardgas + kabel

Elektriciteit + aardgas + kabel + riolering

Elektriciteit + aardgas + riolering

Elektriciteit + riolering

Key figures Fluvius (december 2019)

Managed connections

7,2 miljoen

- Electricity 3 500 000
- Heat 1 773
- Sewerage 610 000
- Cable Tv-internet 930 000
- Natural gas 2 200 000

Managed grid length

231 000 kilometer 6x rond de wereld

- Electricity 133 000 km
- Heat 20 km
- Sewerage 12 000 km
- Cable Tv-internet 28 000 km
- Natural gas 58 000 km

Gas and electricity — **300** gemeenten

Sewerage — **85** gemeenten

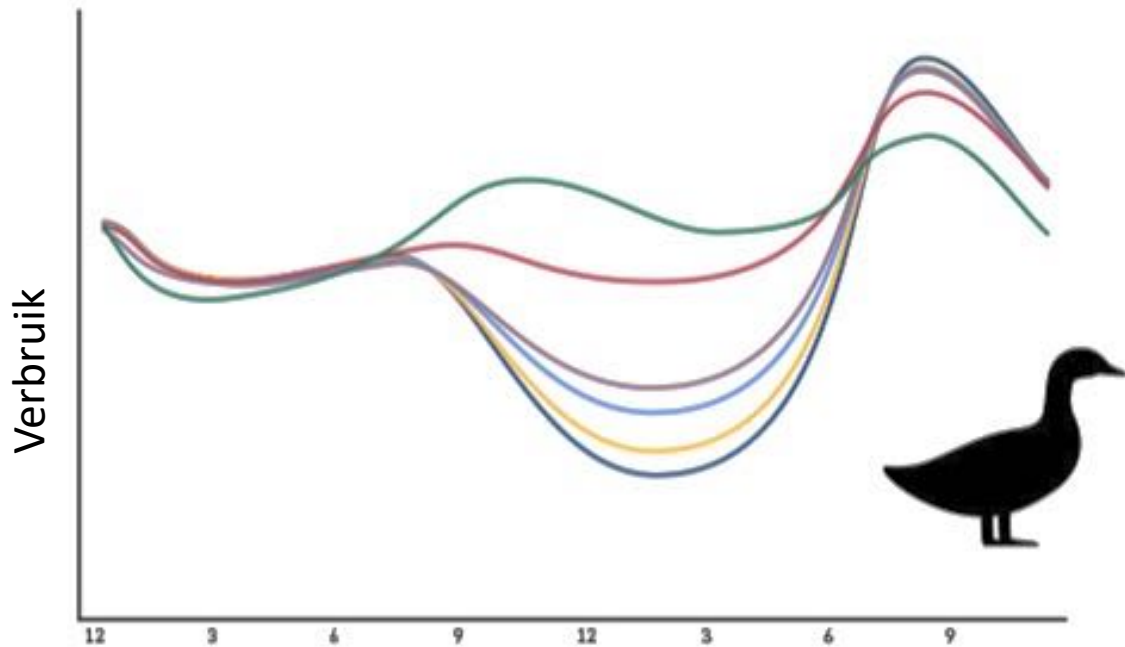Cable TV — **103** gemeenten

Heat — **9** gemeenten

fluvius.

Aiding a greener mobility

fluvius.
Tot bij u

Challenges on the E-grid

- Increase of e-consumption by 55% by 2050 mainly due to electrification in mobility

- More extreme consumption profiles

- Increased consumption peak in the evening

- More (decentralized) renewables during the day

- The evolution of 'the Duck Curve' on a local, as well as on a system level, requires grid investments
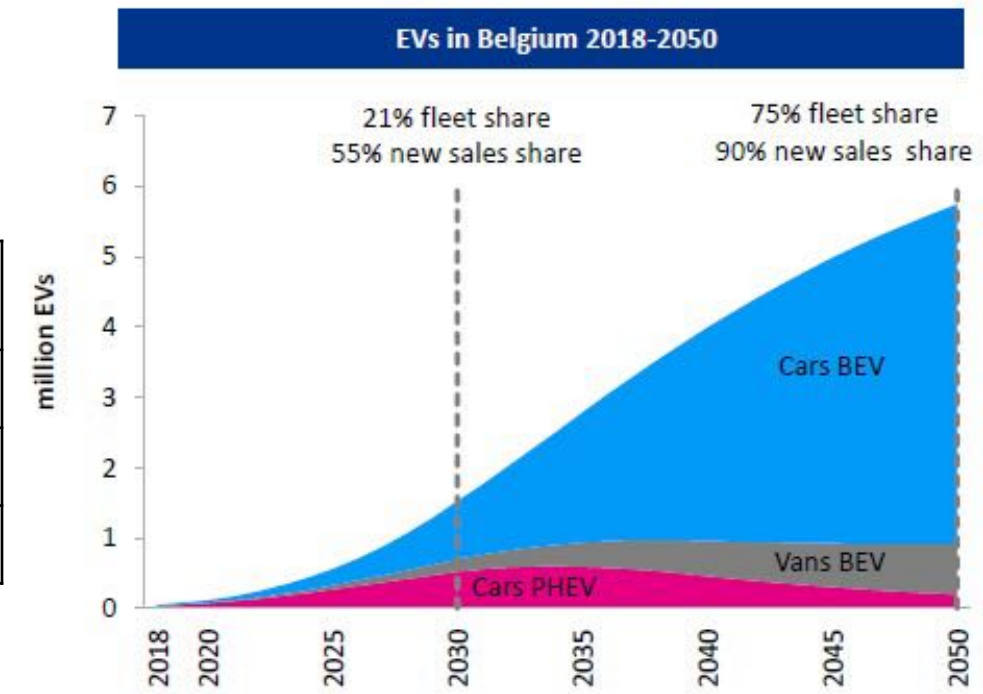
If business as usual continues, Flanders will require an **additional investment** of approximately **5 billion €** during the next 30 years.

# Context electric vehicules

- Evolution electric vehicules:
  - Today +/- 50.000 EV's in Flanders
  - Exponential curve, accelerating between 2025 and 2030
  - From 2026: Federal obligation for zero-emission company cars (700.000)

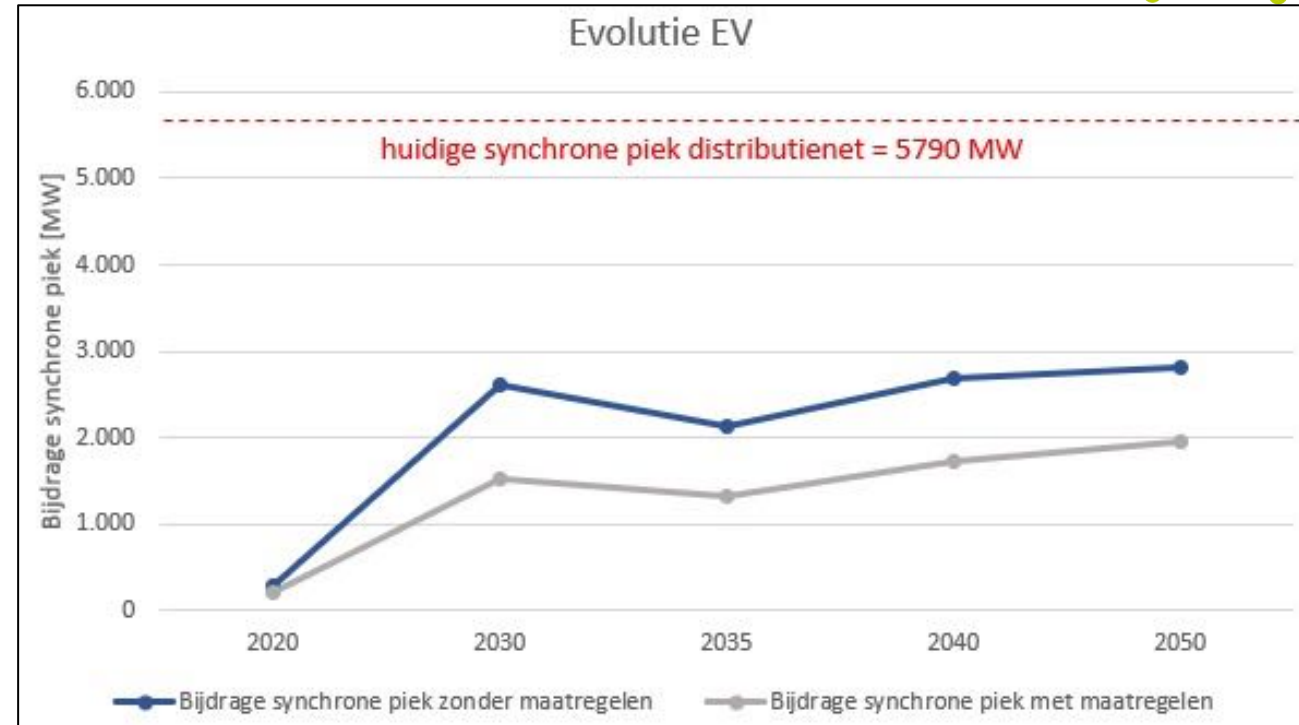|	# EV's in Belgium	# EV's in Flanders	# Hybride	# Full-electric
2025	525.000	350.000	60%	40%
2030	1.500.000	1.000.000	40%	60%
2050	6.000.000	4.000.000		98%

EVs in Belgium 2018-2050

Source: Baringa study

Impact e-Mobility on the Flemisch distribution grid
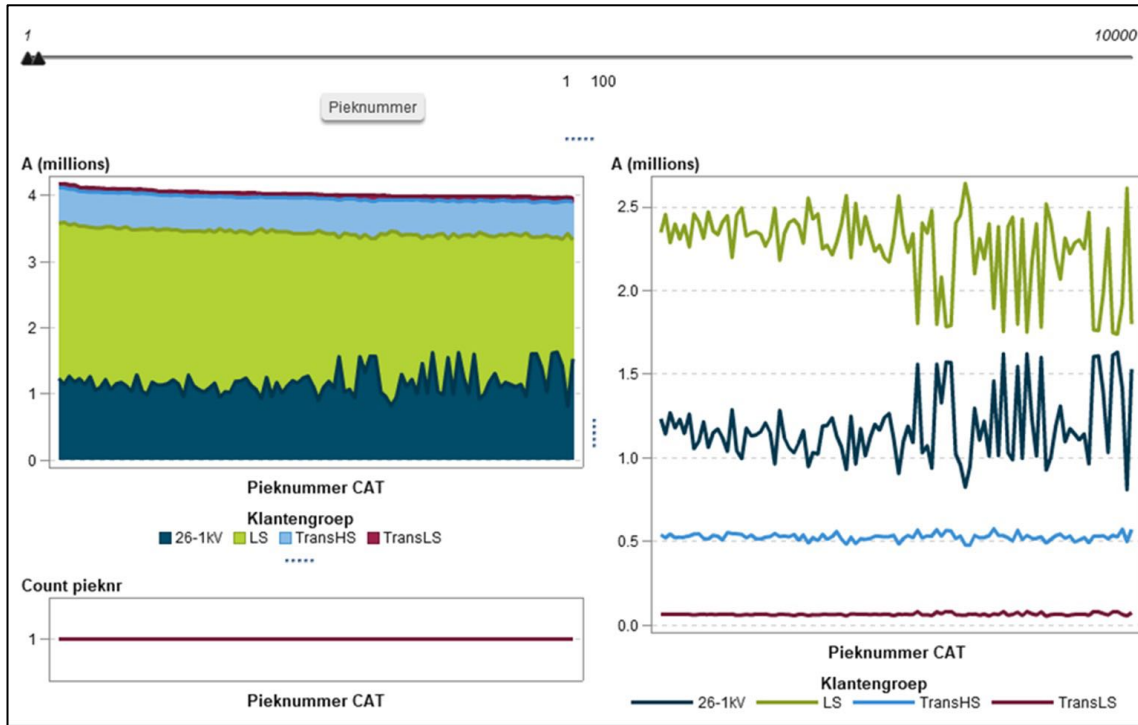
Synchronous peak is for 63%
determined by LV-customers

Rise of e-consumption and
the synchronous peak mainly by e-mobility

If business as usual Flanders will require an **additional investment** of approximately **3,5 billion €** during the next 30 years to electrify the mobility.

Roadmap focus on 5 pillars

1. Providing sufficient grid capacity

2. Realising smart charging behaviour

3. Eliminating technical roadblocks

4. Knowledge acquiring concerning EV usage on flexibiliteit

5. Developing a technical solution to market EV-usage separately

Roadmap focus on 5 pillars

1. Providing sufficient grid capacity

"The EV-driver wants to keep his comfort level."

"Strengthening of the grid on the right moment!"

- Forecasting
  - Market developments
  - Monitoring the LV-grid – digitalisation track
  - Frequent evaluation of our design policies
- Assigning investments on a yearly basis
- Rationalisation of network use
  - Connection of charging infrastructure on MV to the maximum
- Develop our strategy concerning a parallel grid on wheels

Roadmap focus on 5 pillars

2. Realising smart charging behaviour

- Monitoring

- Introducing regulatory guidelines

- Evolution in droop control

- Creating awareness and informing the consumers

Roadmap focus on 5 pillars

3. Eliminating technical roadblocks

- Creation of technical directives

- Customer orientated interaction tools

- Providing technical grid information to third parties
  - Public charging infrastructure
  - Private charging infrastructure

- Adjusting our own process to ensure swift response to customer demands

Roadmap focus on 5 pillars

4. Knowledge acquiring concerning EV usage on flexibiliteit

- Follow-up on the market developments (vehicle to x...)

5. Developing a technical solution to market EV-usage separately

- Transfering the current technical solution to a MIG6 compatible solution (Headpoint + SDP)
- Resdidential vs. appartments vs. industrial

Creating new possibilities for active consumers

fluvius.

We create new possibilities for active consumers

We inform customers more and communicate proactively concerning the state of the electricity grid

We are open for alternative solutions that help avoiding grid-investments

Recap: Why the need for "alternative solutions"

EVOLUTION PEAK LOAD ON THE E-GRID vs. available capacity

- more E-**volume** (+55% kWh by 2050)
- consumption **profile** new applications *(EV, PV)*
- **controlled** simultaneity by the market
  (dynamic pricing, Elia demand)

EVOLUTION LEGISLATION

CEP Package & VREG:

Obligation on flexibility as an alternative for investments

Actual cooperation between STAKEHOLDERS
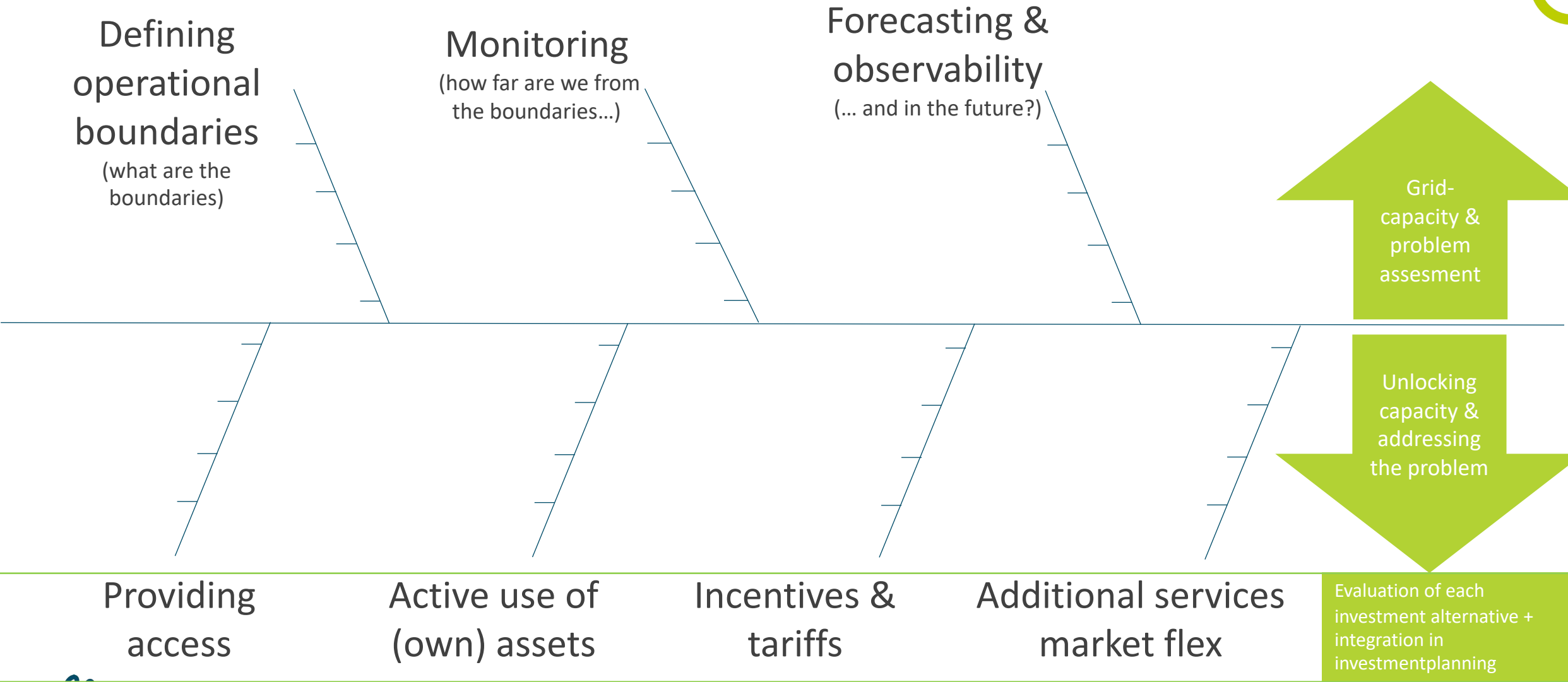
Elia: complex planning processus (CAPAC / Ppad / Icaros..)

We define necessary actions

Order / priorities on actions are not always in our span of control

Capability fishbone

Defining operational boundaries
(what are the boundaries)

Monitoring
(how far are we from the boundaries...)

Forecasting & observability
(... and in the future?)

Grid-capacity & problem assesment

Unlocking capacity & addressing the problem

Providing access

Active use of (own) assets

Incentives & tariffs

Additional services market flex

Evaluation of each investment alternative + integration in investmentplanning

In comparison to our road network…

Defining operational boundaries

Monitoring

Forecasting & observability
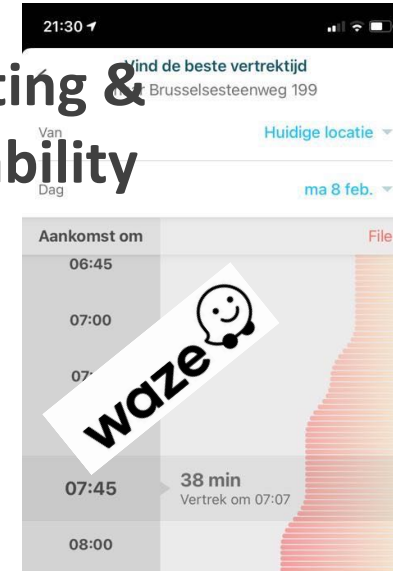
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Additional services Market flex

Roadmap item Traffic light

- **Problem**

  - Due to electrification an increased usage and higher peak loads on our grid

- **Solution**

  - Only grid investments if they are justified
  - In other cases active netmanagement with alternative solutions
    - From a simple traffic light system green/red (capacity available/not-available)
    - … to dynamic speed limits (capacity is variable in time)
    - Logic steps

Next steps

- Unlocking of data (Digital Meter & Data Monitoring System) and combining this data to acquire insights
- Visualisation and follow up of the grid (Digital twin)
- Impact analyses and adjusting the cunsumption profiles following incentives, additional electrification, flexible products…
- Predicting future grid-congestion
- Communicating the limits of the grid exterally
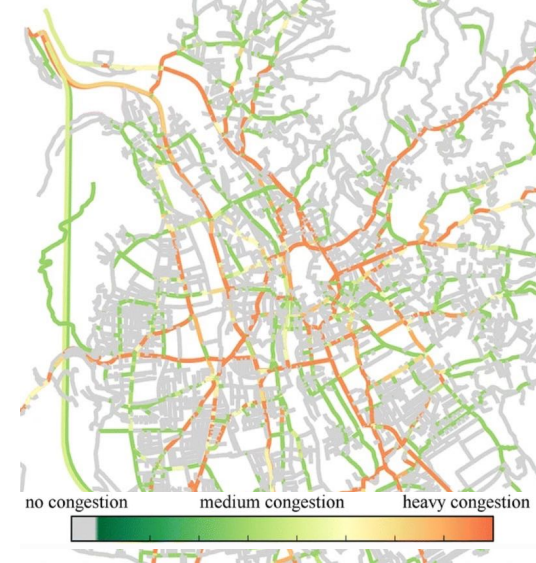
➔ **The purpose is clear, every step we take moves us in the right direction**

no congestion   medium congestion   heavy congestion

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Thank you for your attention

Balancing the future grid

Thomas Smets

BLOCKCHAIN 101

CHALLENGES OF THE FUTURE GRID

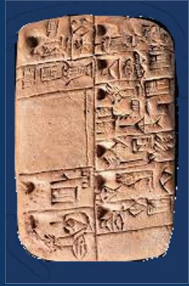**THE TECHNOLOGY STACK**

USE-CASES

CHALLENGES

BLOCKCHAIN 101 | Markets and ledgers

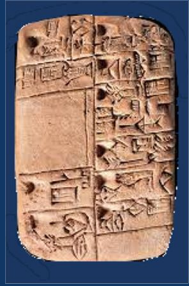Doing business = Recording trade transactions
- Exchange ownership of goods and services
- Contracts which determine the terms and conditions to exchange ownership of goods and services in the future

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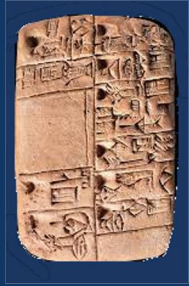

Ledger = Record keeping system of all transactions

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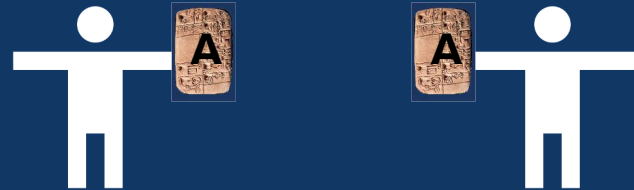
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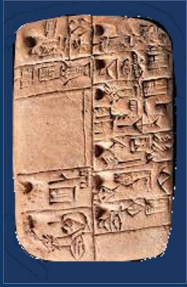Ledger = Record keeping system of all transactions

Trust and consensus?
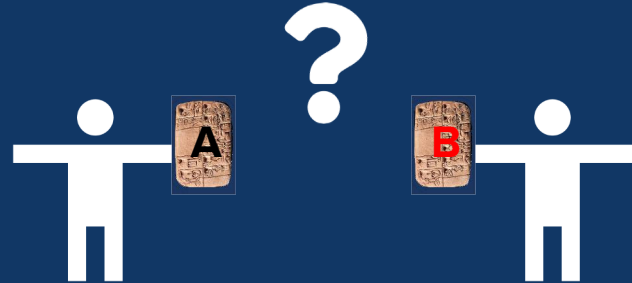
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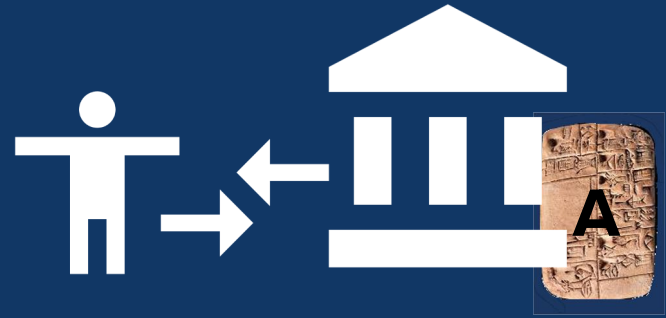Ledger = Record keeping system of all transactions

Trust and consensus?

BLOCKCHAIN 101 | Traditional markets

Trusted third parties (institutions) are
responsible to maintain a general ledger

- (Central) Banks
- Clearing houses
- CSDs
- Notaries
- Municipalities
- …

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Limitations

- Single point of failure
- Friction
- Innovation
- **Data fragmentation**
  - Multi-party workflows
  - Redundancy

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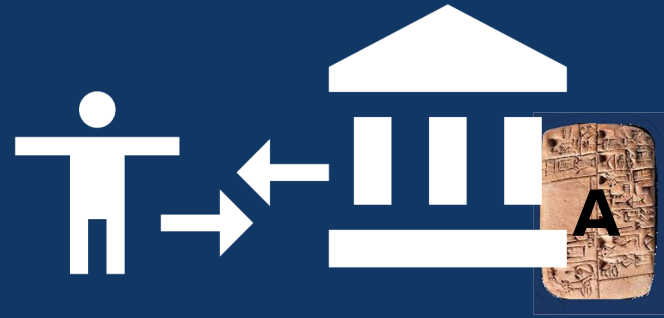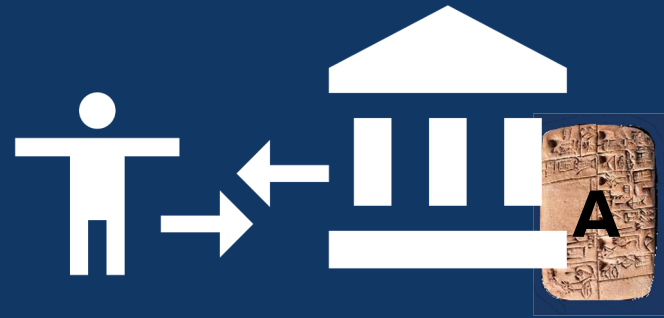 - Multi-party workflows
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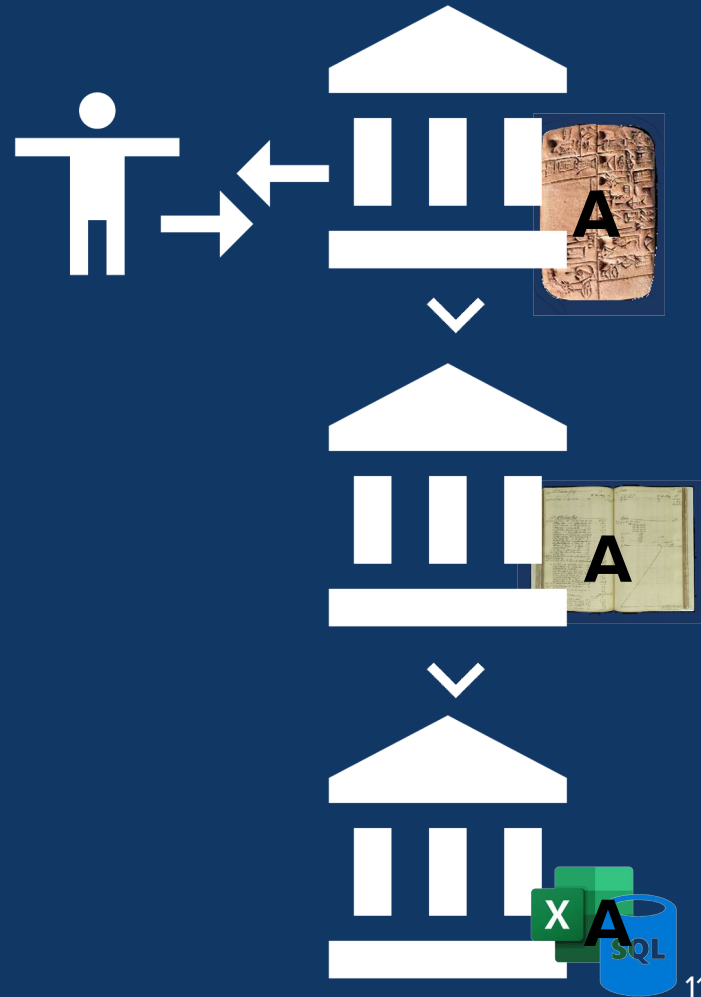
BLOCKCHAIN 101 | What is Blockchain

A blockchain is a digital distributed ledger, where all participants can send transactions asynchronously, but that still maintains consensus among all participants about the order of the transactions

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  - Ownership of goods (tokens)
  - Contracts
    - Programmable contractual agreements
    - Self executing when conditions are met
      -> Smart contracts
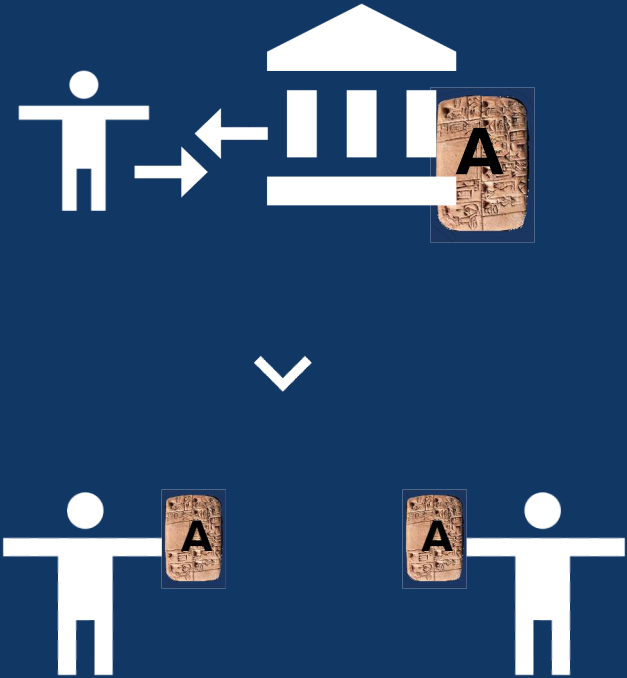
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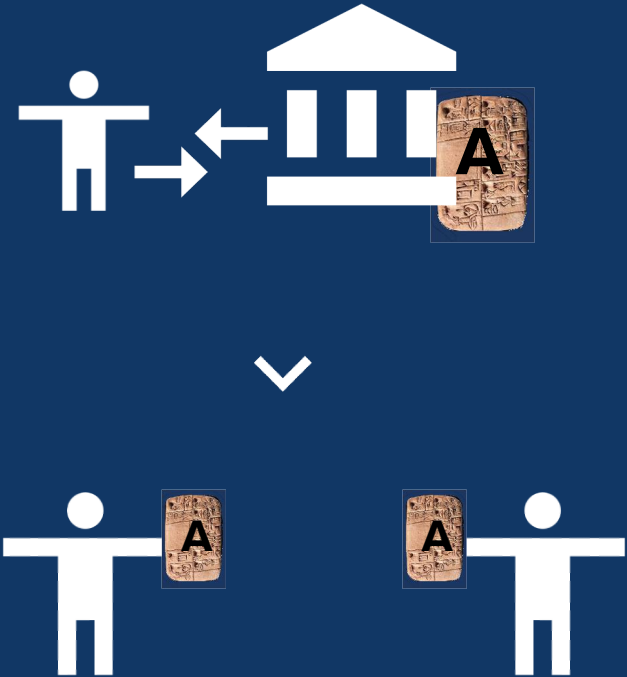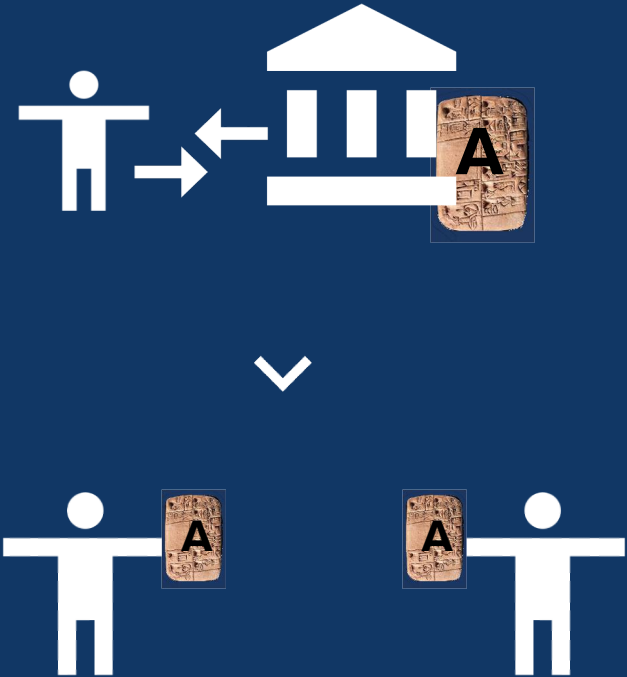
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- Consensus
  - The famous consensus protocols: POW, POS, POA, PO...
  - Fixed order of transactions
  - Cryptographically secured that each transaction adheres to the ruleset
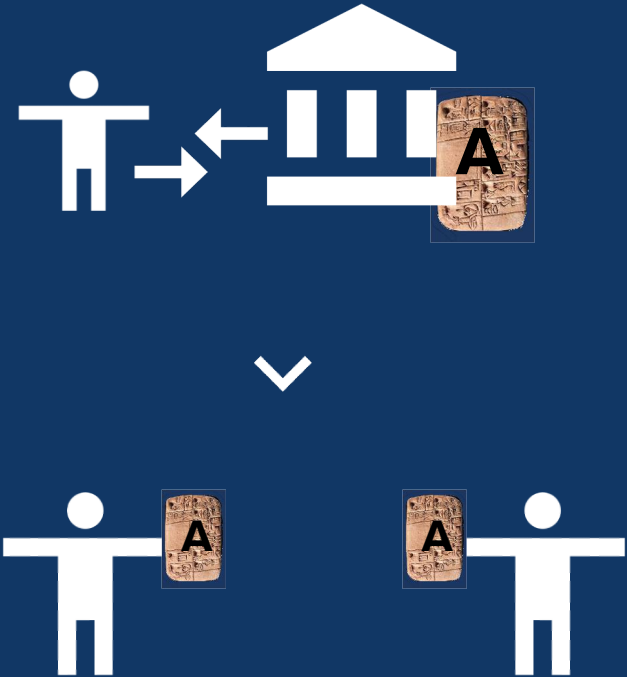
BLOCKCHAIN 101 | Dapps
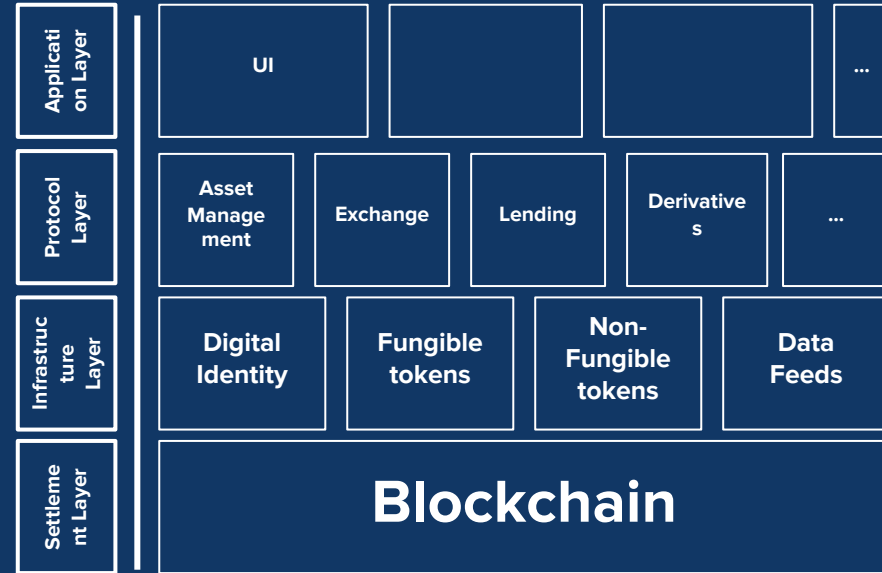
Application Layer		UI			...
Protocol Layer		Asset Management	Exchange	Lending	Derivatives	...
Infrastructure Layer		Digital Identity	Fungible tokens	Non-Fungible tokens	Data Feeds
Settlement Layer		Blockchain			

BLOCKCHAIN 101 | Dapps

Applicati on Layer		UI		...

| Protocol Layer | Asset Manage ment | Exchange | Lending | Derivative s | ... |

| Infrastruc ture Layer | Digital Identity | Fungible tokens | Non-Fungible tokens | Data Feeds |

| Settleme nt Layer | **Blockchain** |

Settlement Layer

Allows the network to store **ownership information** securely and ensures that any state changes adhere to its ruleset in a **trustless** way.

BLOCKCHAIN 101 | Dapps

Infrastructure Layer

Consists of all digital **identities** and **assets** that are issued on top of the settlement layer (usually referred to as tokens).

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BLOCKCHAIN 101 | Dapps

Protocol Layer

Provides standards for specific **use cases** such as lending, exchanges, data sharing, and on-chain asset management. These are implemented as a set of **smart contracts** and can be accessed by any user (or application).

Infrastructure Layer

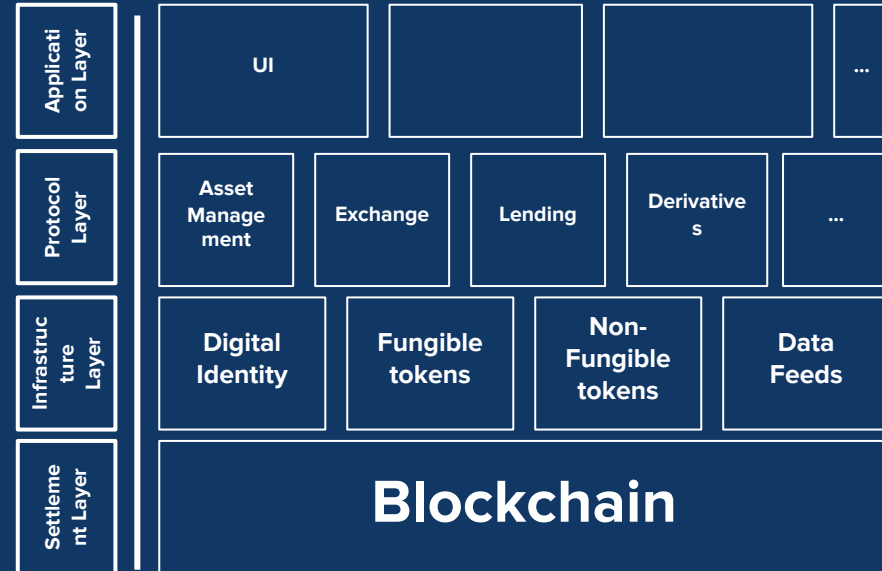Consists of all digital **identities** and **assets** that are issued on top of the settlement layer (usually referred to as tokens).

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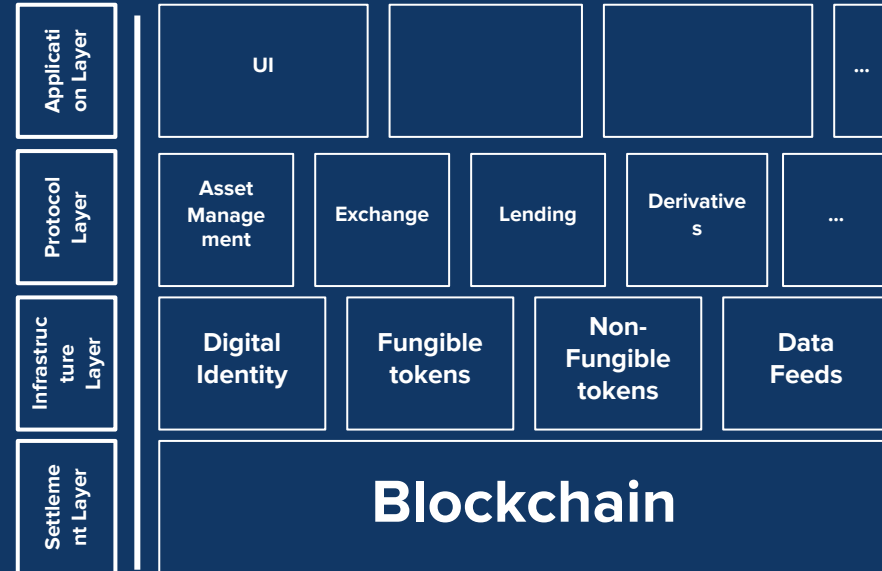
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User-oriented applications that **connect** to one or more protocols. The smart contract interaction is usually abstracted by a web browser-based front end.
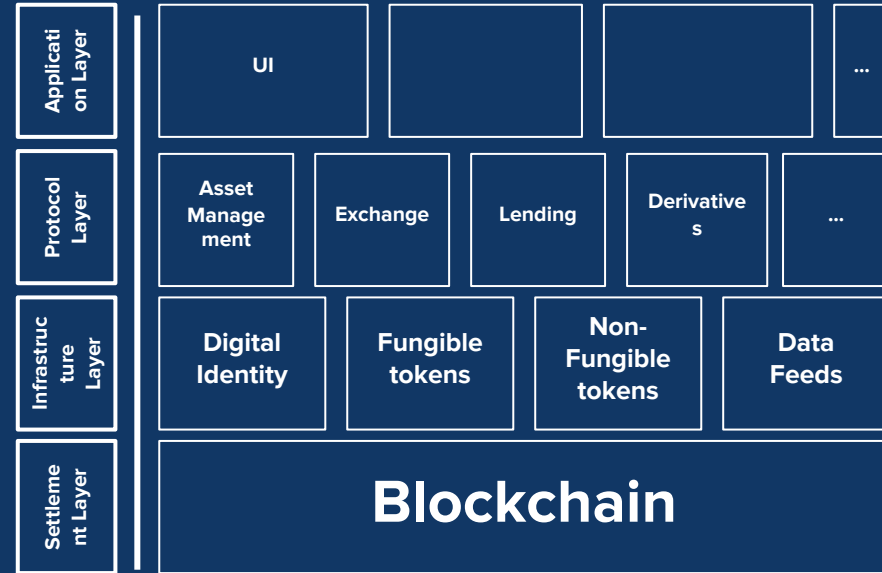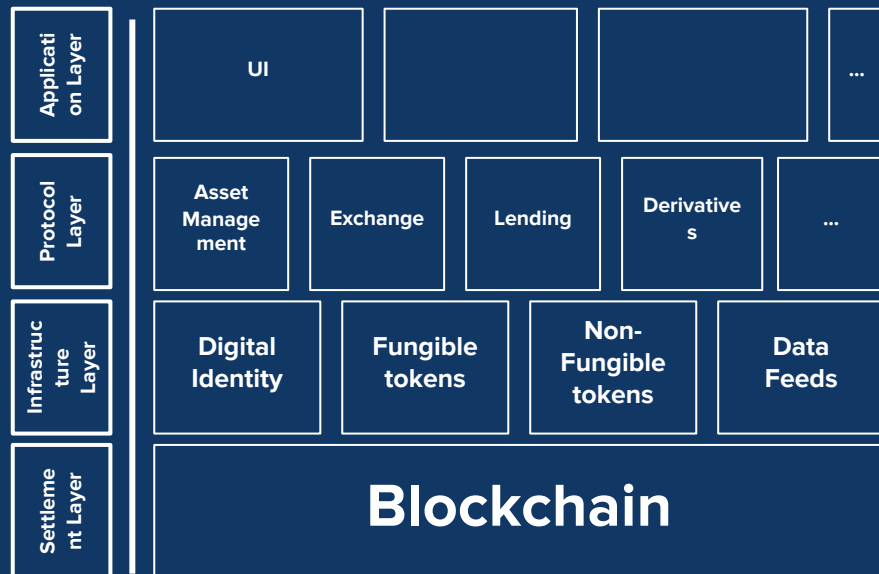
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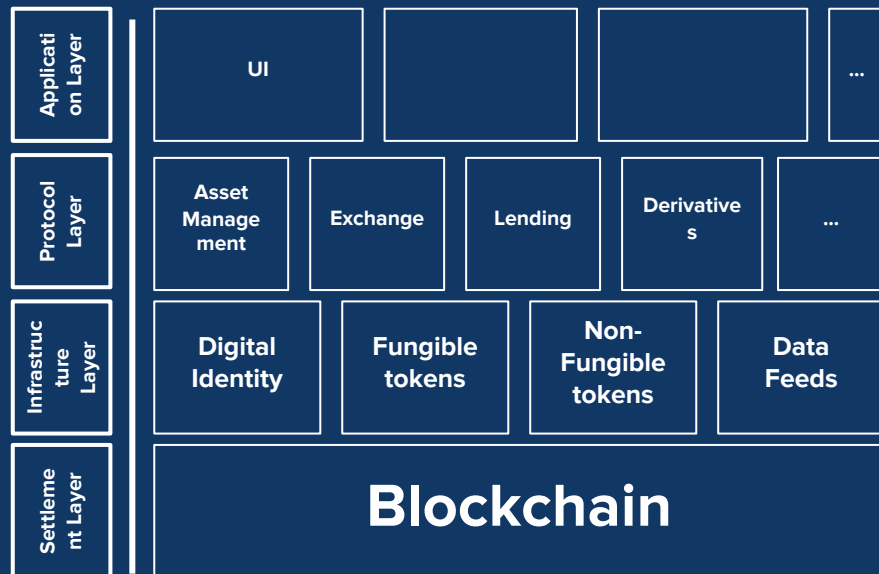
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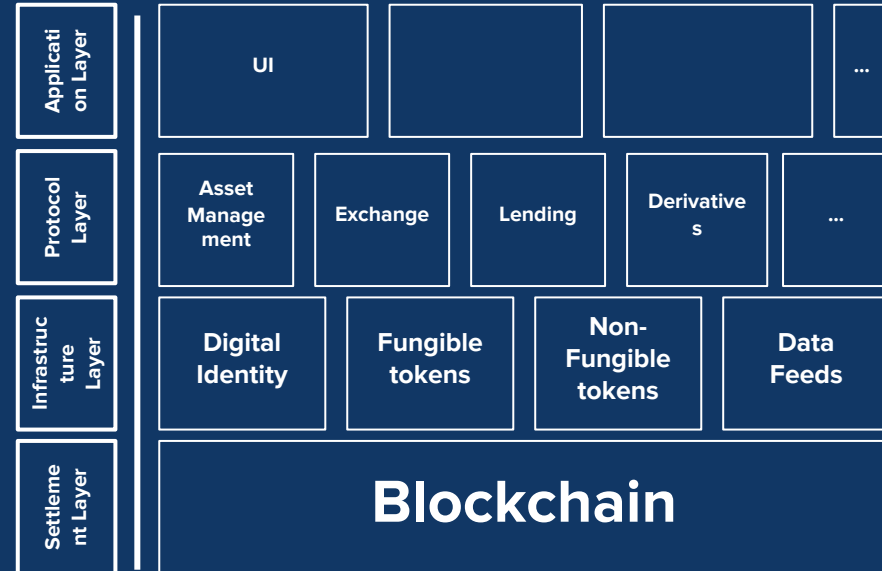Allows the network to store **ownership information** securely and ensures that any state changes adhere to its ruleset in a **trustless** way.

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BLOCKCHAIN 101 | Dapps advantages

Advantages

- No data silo's
- SC auto execute when conditions are met, no manual actions needed -> scalable applications
- Composable
- Open Source
- Transparent
- Trustless

Application Layer	UI			...
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CHALLENGES OF THE FUTURE GRID | Power market as is

Wholesale Market

Generators

Industrial Consumers

System Operator

Suppliers

Retail Market

Balancing the grid:
- Energy balancing via market mechanisms
- Ancillary services
  - Flexibility markets
  - Reactive power compensation
  - Black start capability
  - ...

Wholesale market
- Limited number big centralised utilities
- Quarterly variable energy prices
- Offer all flexibility/services

Retail market
- Yearly fixed price contracts
- Inflexible, unintelligent

CHALLENGES OF THE FUTURE GRID | Transitions

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  - Loss of flexibility supply side
  - Consumers become prosumers

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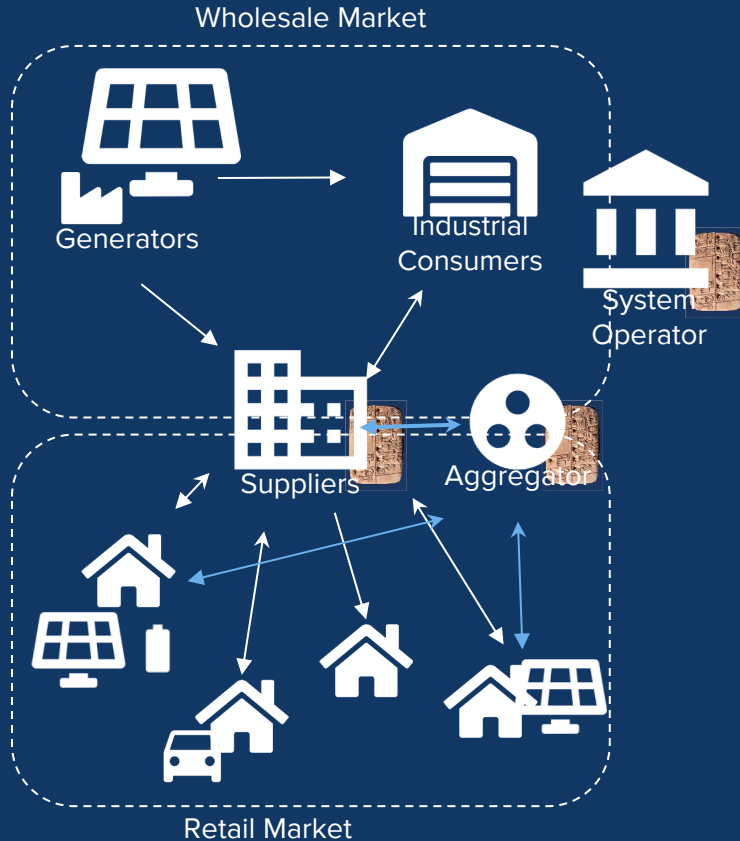
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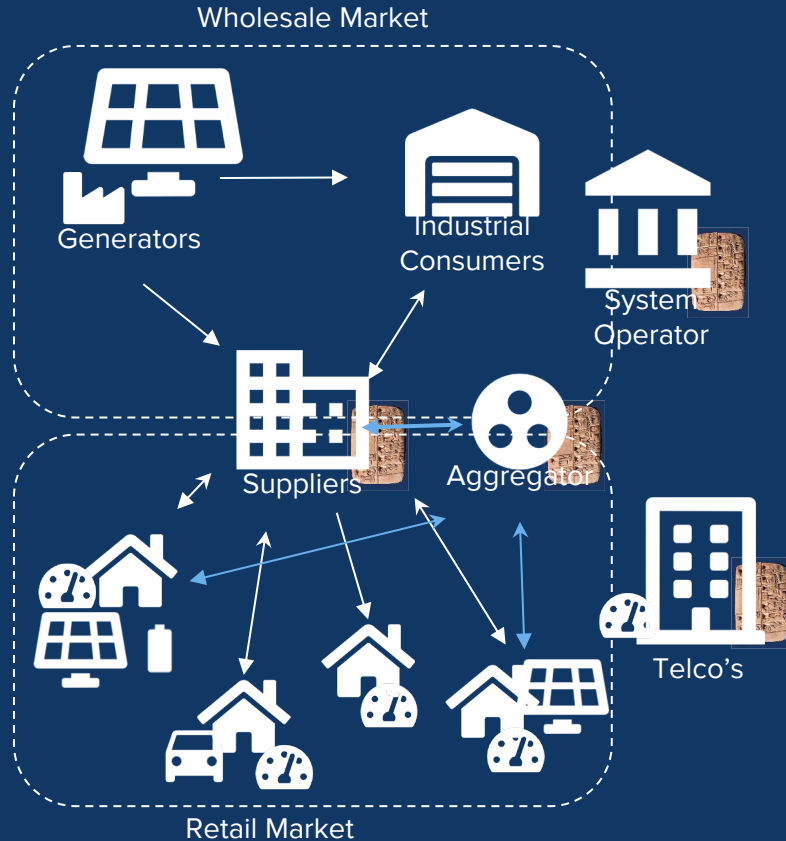System Operator

Suppliers

Aggregator

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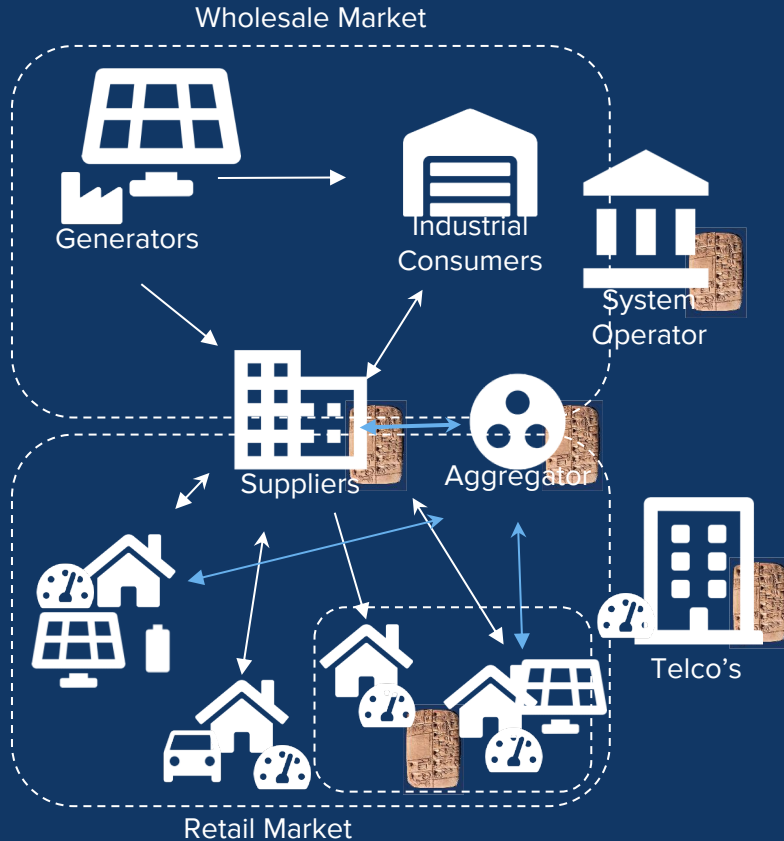# CHALLENGES OF THE FUTURE GRID | Transitions

Transitions

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- Demand side flexibility
- Data Economy, IOT
- Privacy concerns

CHALLENGES OF THE FUTURE GRID | Transitions

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Generators

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Telco's

Retail Market

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- Citizen empowerment
  - Microgrids
  - Cooperatives
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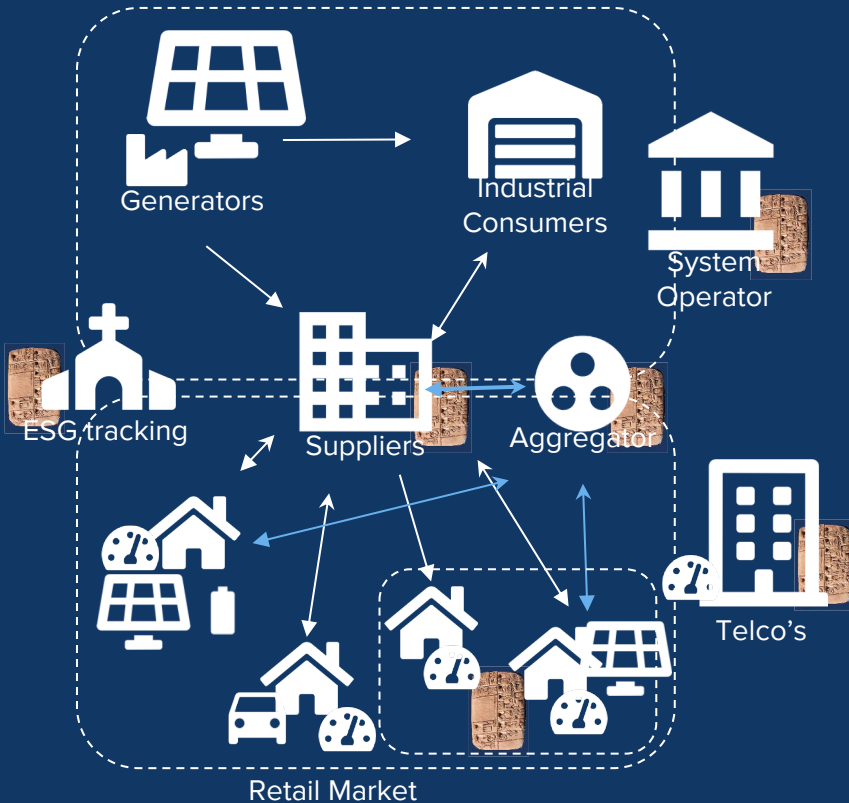# CHALLENGES OF THE FUTURE GRID | Transitions

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  - ...
- Transparency

CHALLENGES OF THE FUTURE GRID | Transitions

Wholesale Market

Generators

Industrial Consumers

System Operator

ESG tracking

Suppliers

Aggregator

Telco's

Retail Market

Transitions
- Shift from fossil fueled power plants to distributed renewable energy
  - Loss of flexibility supply side
  - Consumers become prosumers
- Electrification of the demand side
- Demand side flexibility
- Data Economy, IOT
- Privacy concerns
- Citizen empowerment
  - Microgrids
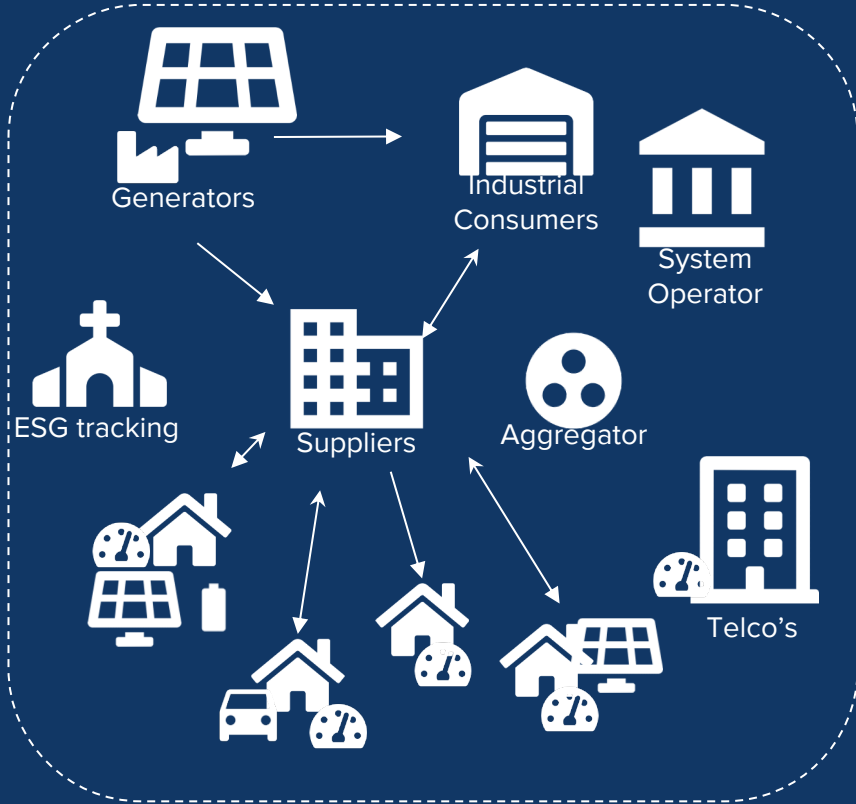 - Cooperatives
  - ...
- Transparency

Grid of the future:

Enable any energy asset, owned by any customer to participate in any energy market
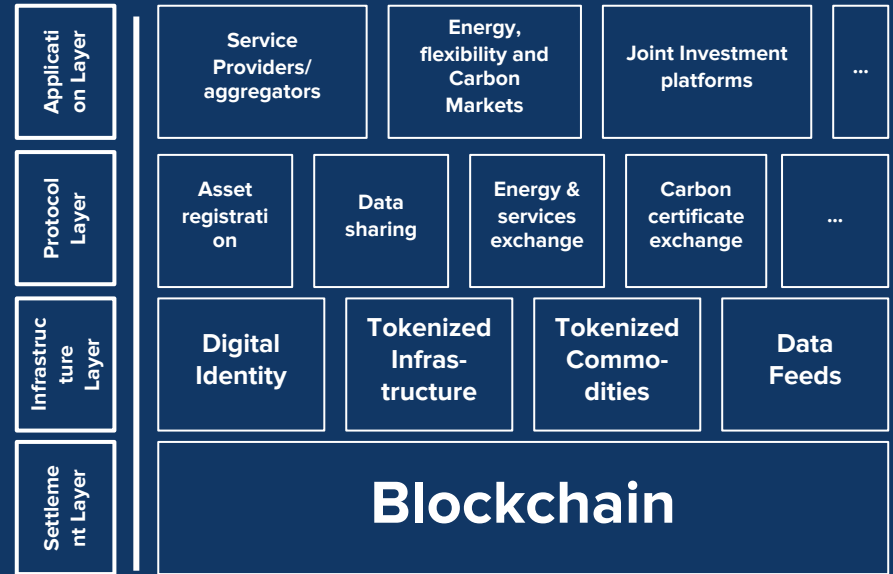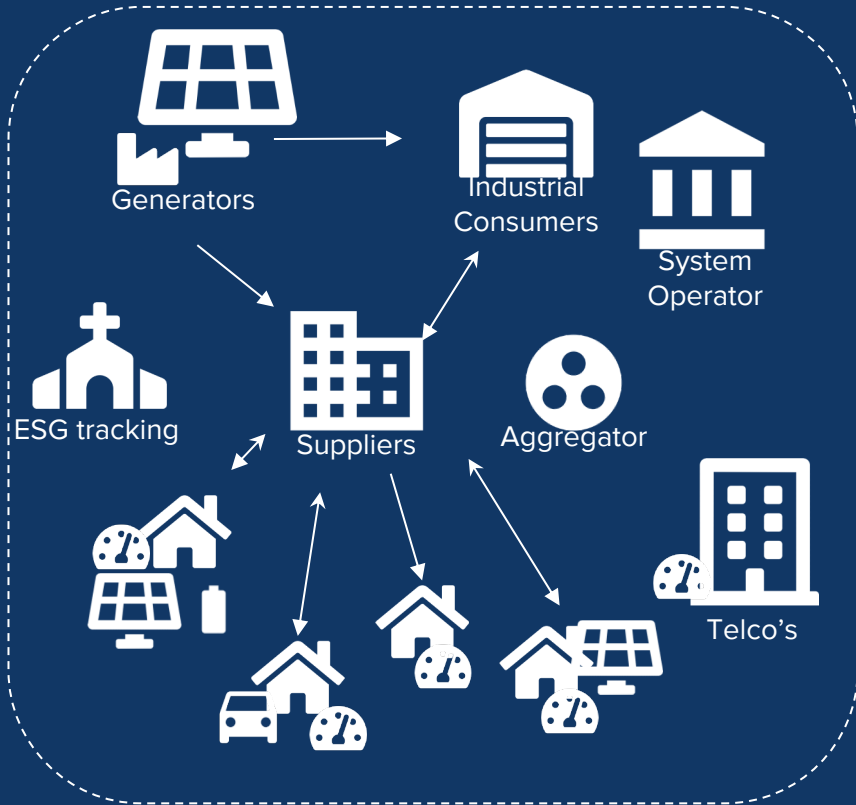
THE TECHNOLOGY STACK

Enable any energy asset, owned by any customer to participate in any energy market
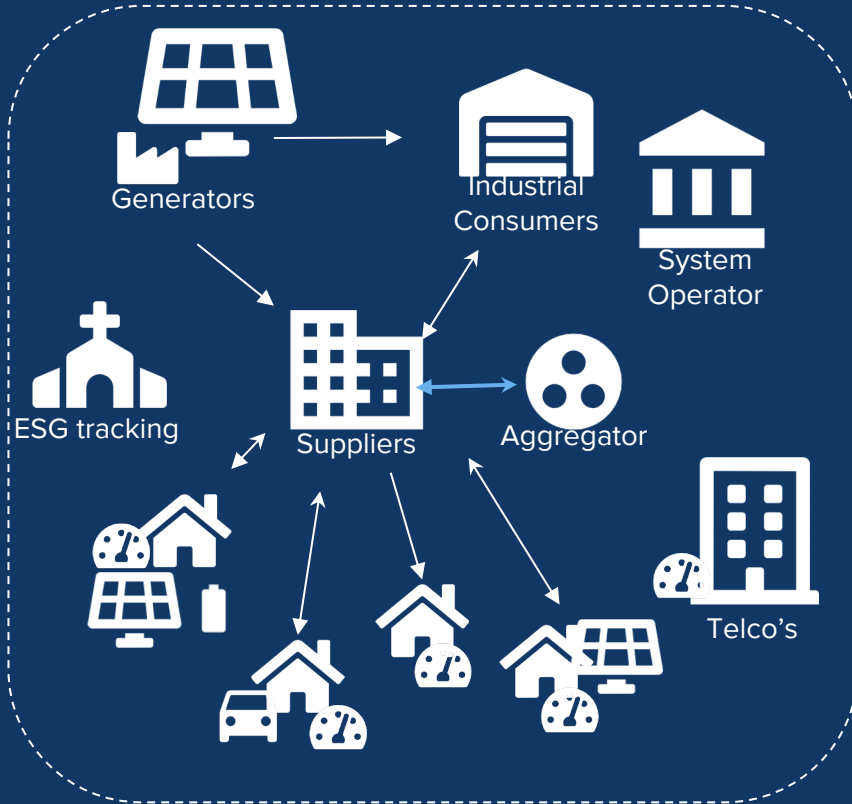
THE TECHNOLOGY STACK

Application Layer	Service Providers/ aggregators	Energy, flexibility and Carbon Markets	Joint Investment platforms	...
Protocol Layer	Asset registration	Data sharing	Energy & services exchange	Carbon certificate exchange	...
Infrastructure Layer	Digital Identity	Tokenized Infrastructure	Tokenized Commodities	Data Feeds
Settlement Layer	Blockchain			

Diagram labels: Generators, Industrial Consumers, System Operator, ESG tracking, Suppliers, Aggregator, Telco's

Enable any energy asset, owned by any customer to participate in any energy market

USE CASES

- Demand side flexibility

- Electric vehicles

- Data sharing

- KYC and Identity

- Entirely new markets (congestion management, peak shaving, microgrids...)

CHALLENGES

- Blockchain for one use case alone doesn't make sense

- Coupling with the physical grid
  - Trust metering data
  - Infrastructure = natural monopoly

- The Blockchain Trilemma
  - Decentralisation
  - Scalability
  - Security

THANK YOU

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Next session

Prof. Erik Delarue   Dr. Kenneth Bruninx

KU LEUVEN

Energy Systems Integration & Modeling

Lien Van Schepdael

FLEXCITY *by* **VEOLIA**

Technical account manager

Thank you!