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# New Energy World with the Help of Blockchain

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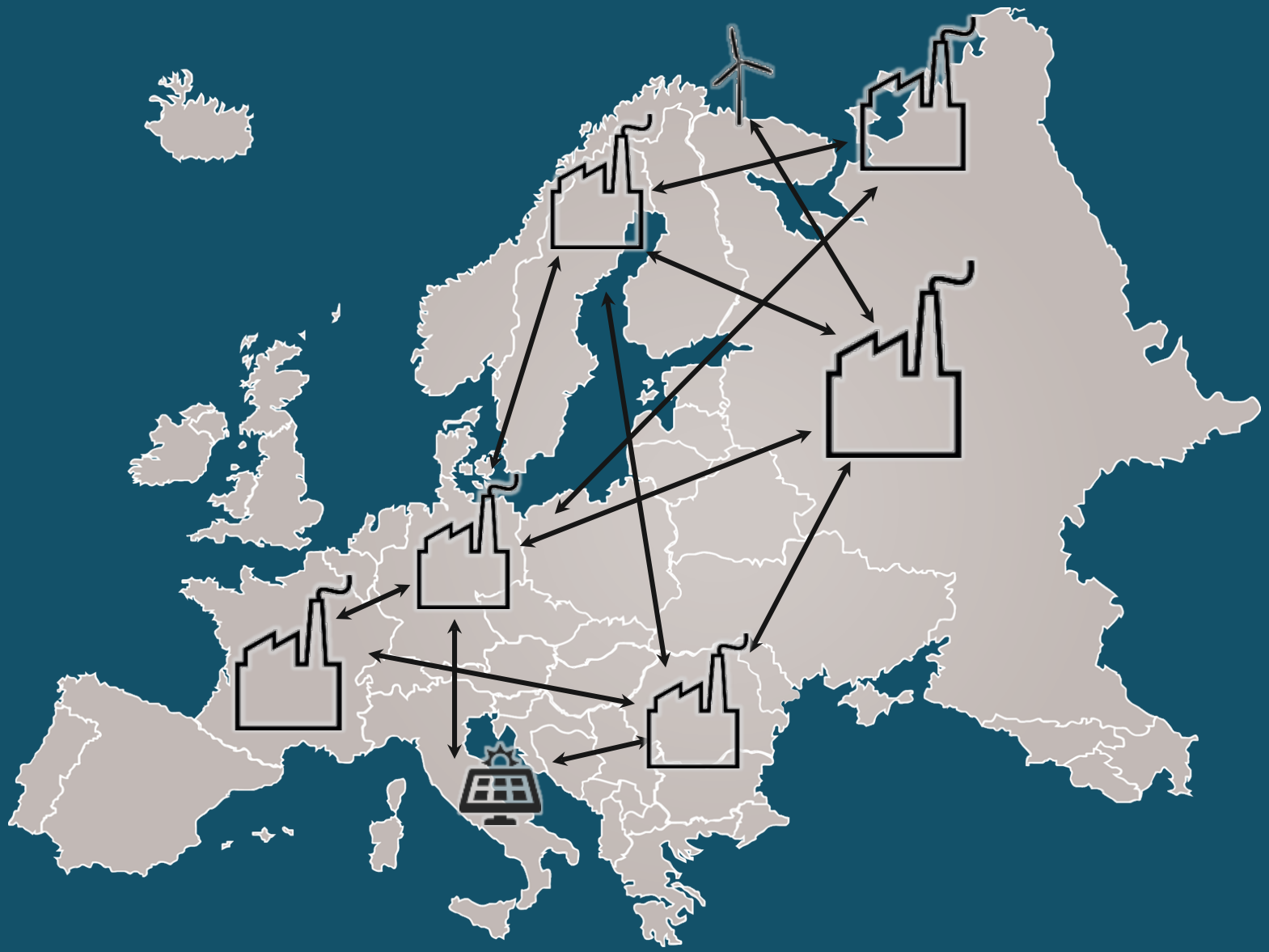
# The energy landscape …



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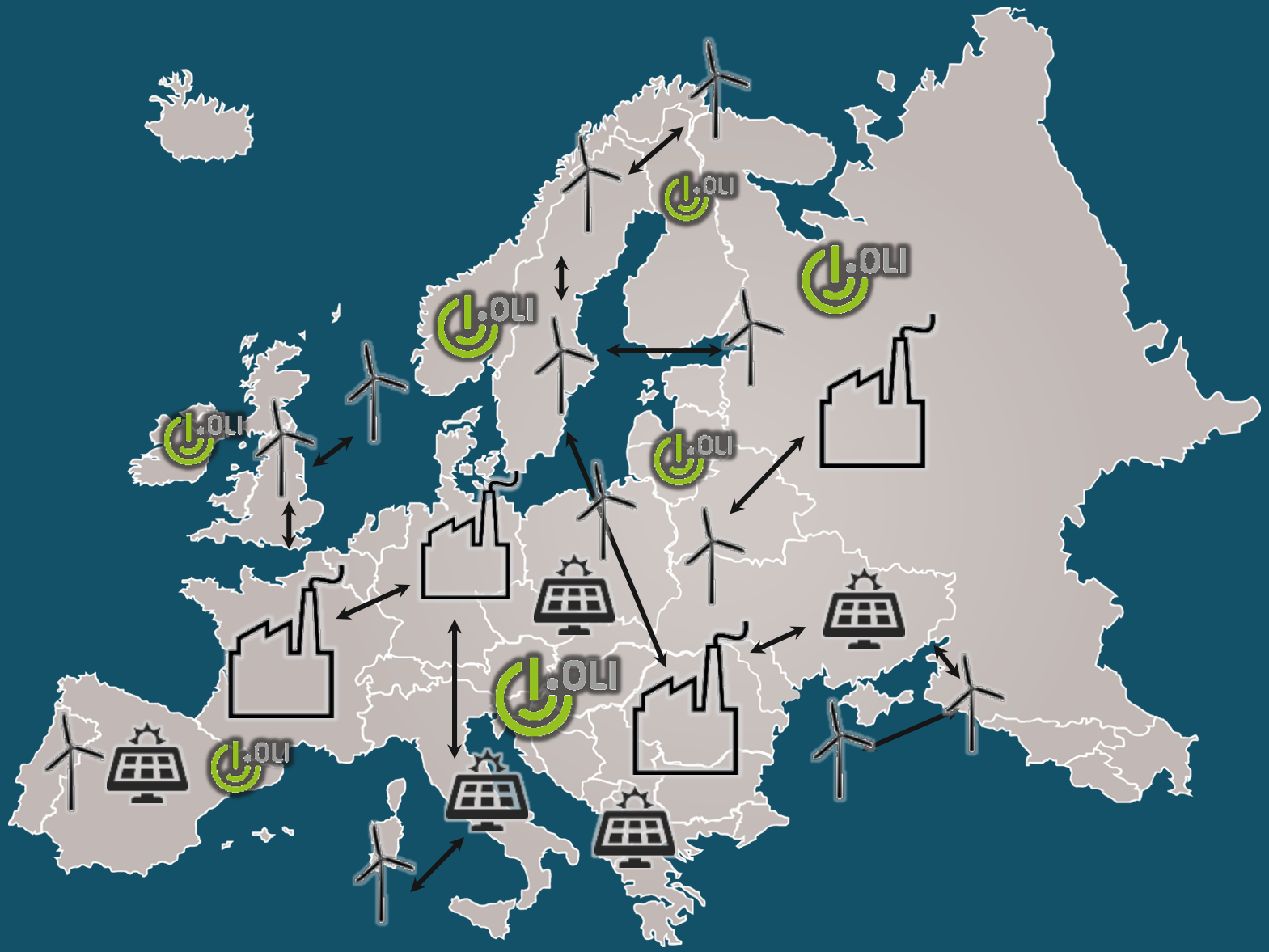
# …is getting more and more distributed



# Blockchain Operating system for the energy transition

Data Sovereignty

Tamper Proof

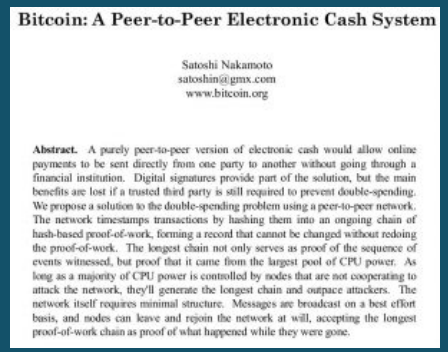
Distributed System

Open Source

# How did the technology develop?

## Satoshi and Friends

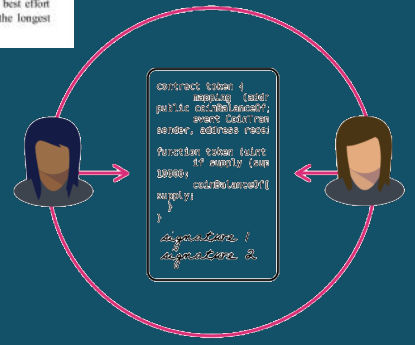
- **1980s:** Various works on agreement protocols
- **1991:** Haber/Stornetta: Time-stamping of digital documents
- **2008:** Nakamoto: Adding blocks without a trusted third party
- **2013:** Buterin: Ethereum/Smart Contracts

Bitcoin: A Peer-to-Peer Electronic Cash System

Satoshi Nakamoto
satoshin@gmx.com
www.bitcoin.org

**Abstract.** A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.



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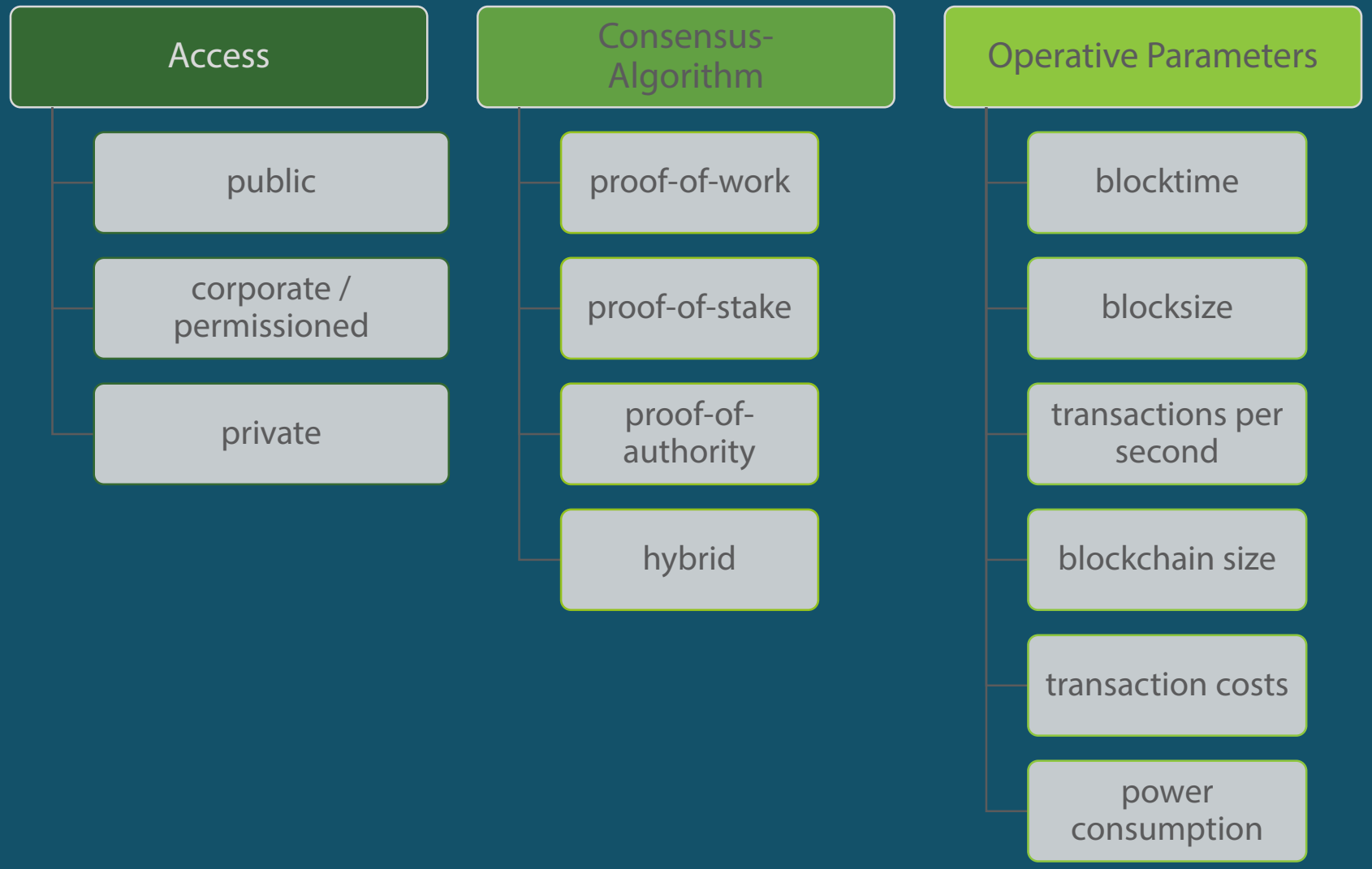
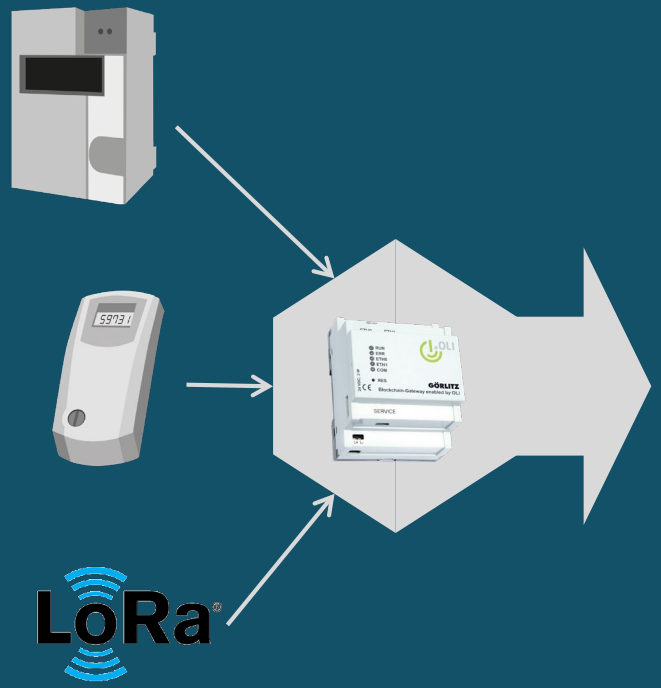
# Blockchain Cheat Sheet

## What's important

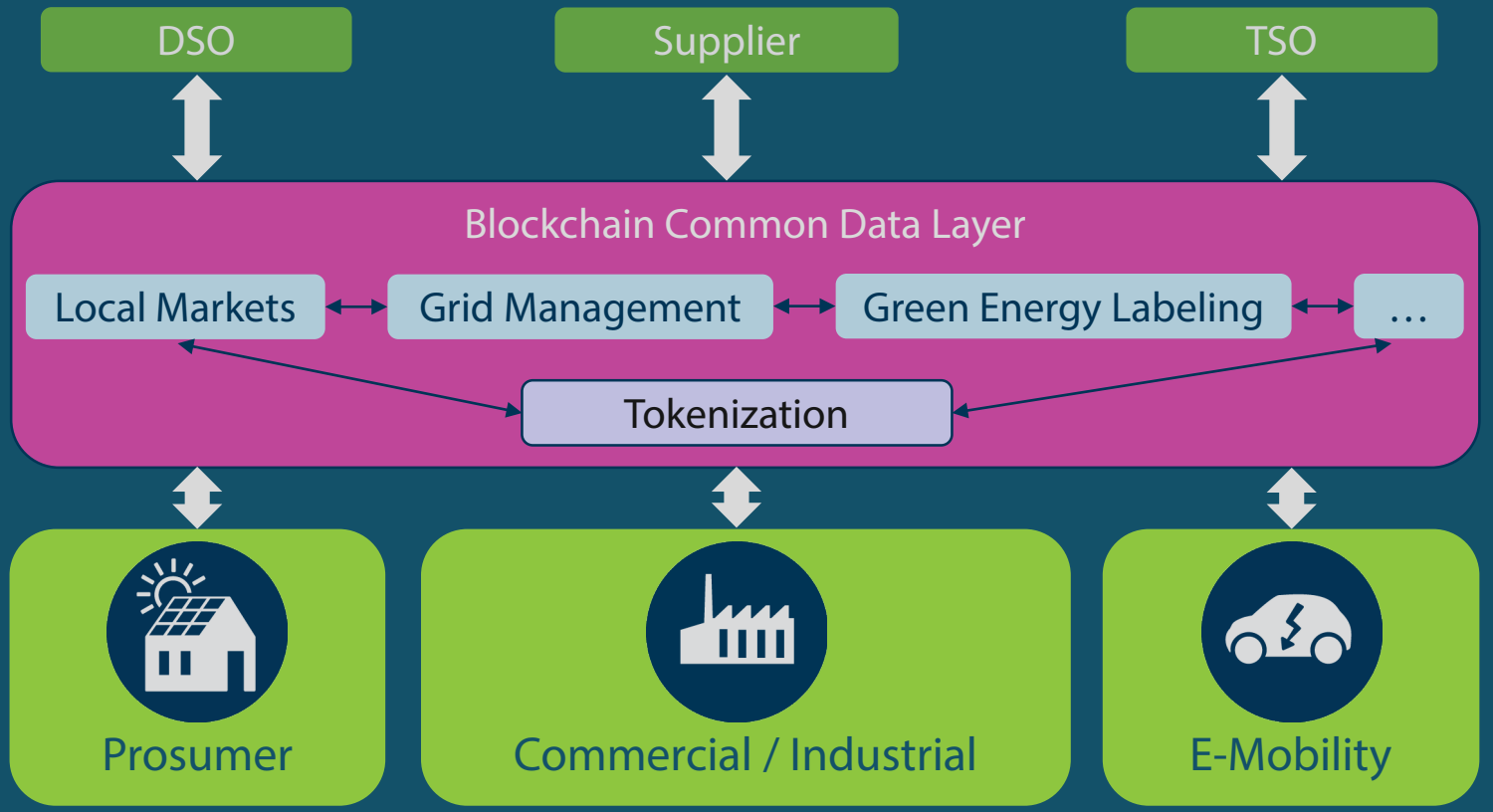


# A common data layer for all use cases

## Blockchain architecture

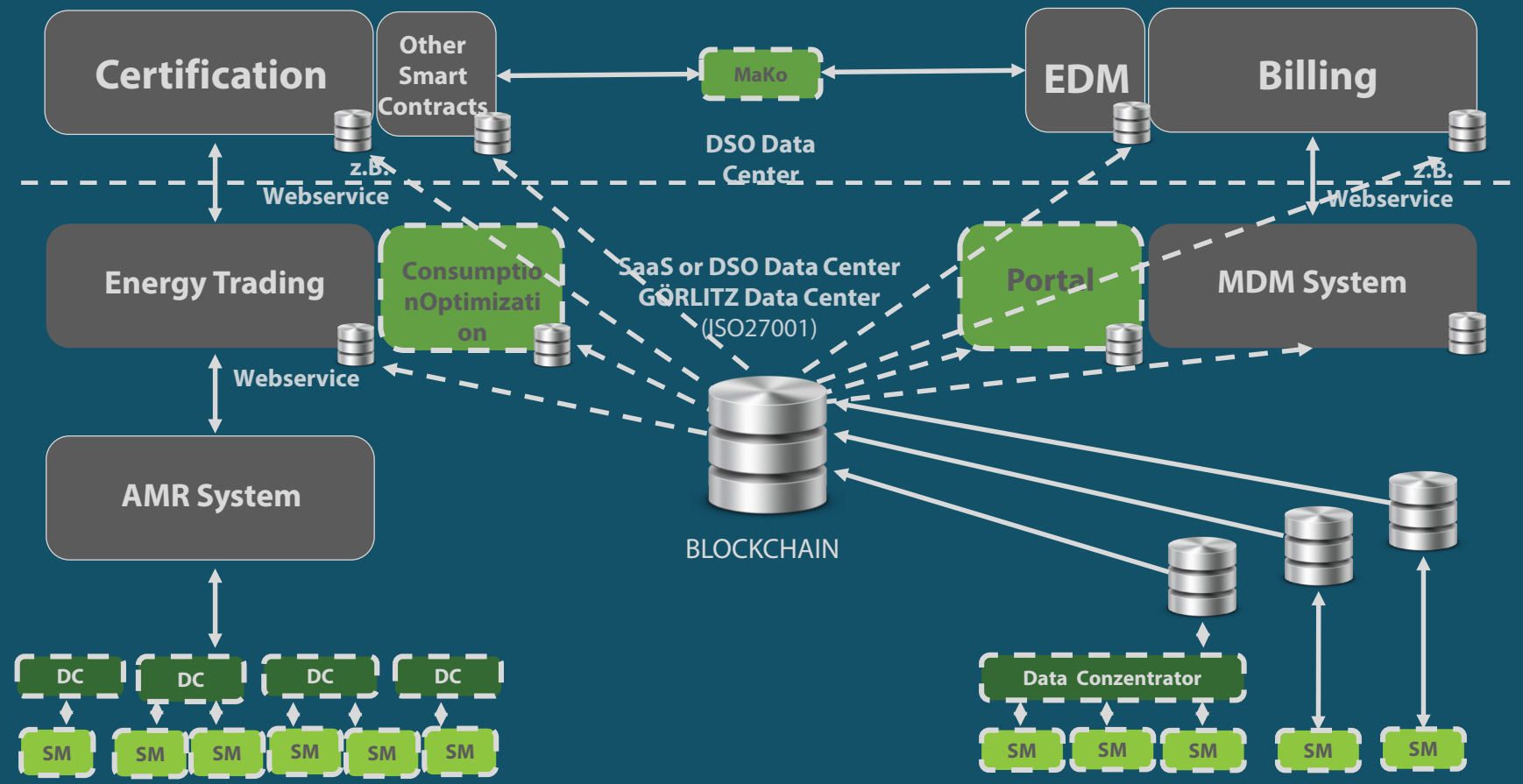



Free Choice of Sensory Signal and Data Input and/or Exchange



# Data Acquisition with Blockchain-Gateway

## Direct data transfer into the Blockchain enables new areas of application




Classic AMR Data Akquisition

BCGW Messtechnik

# From blockchain core to business cases

## OLI eco system

**OLI Label**

Immutable and efficient real time tracking of power

**OLI Move**

Grid sound integration of E-vehicles through flexible charging

APIs

energy web **BLOCKCHAIN** OLI Node private

SOFTWARE

HARDWARE

APPS

Market assess for all

VALUE PROPOSITIONS

Efficient balance group management with markets

**OLI Market**

PRODUCTS

**OLI Balance**

# Use Case #1: Guarantee of Origin / Certification

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# Challenges

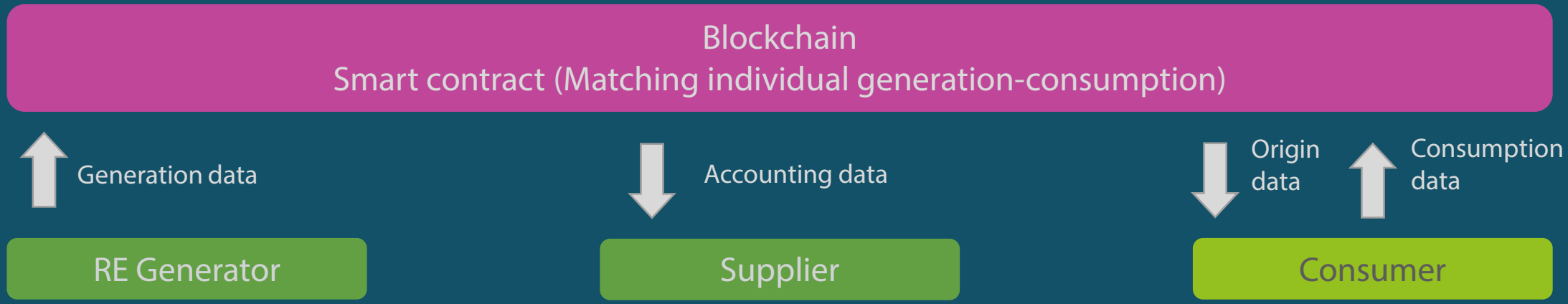
## Guarantee of Origin

- Current European Union Guarantee-of-Origin-system (GoC) complicated with high administrative burdens for all stakeholders
- Intransparent for green power customers
- Certification only on an annual basis
- Transfer of data insecure

# Solution – OLI Label

## Guarantee of Origin

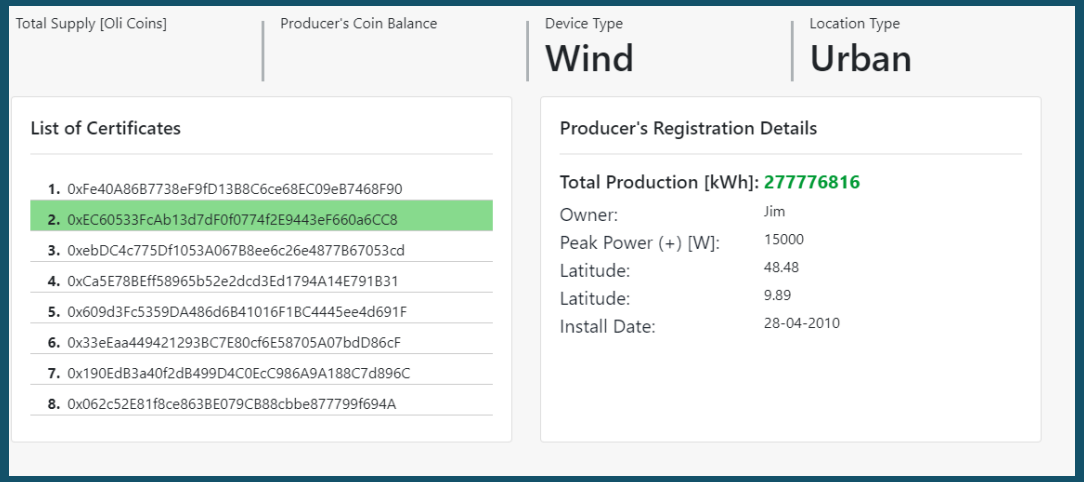
- Permissioned blockchain for producers, suppliers and regulatory authorities as a common data layer
- Trusted real-time information for electricity customers
- Secure hardware oracle that serves as gateway between power plant and ensures communication to permissioned blockchain
- Architecture based on smart contracts that ensure easy transferability of certificates and avoid double spending



# Required components

## Guarantee of Origin

- Blockchain based registry – for example based on the Volta Chain operated by the Energy Web Foundation
- One Vivavis Blockchain Gateway for each asset
- If consumers and producers at the household level are relevant, one OLI box for each household
- A set of Smart Contracts for automated generation, transfer and devaluation of certificates

# Use Case #2: Grid friendly management of assets

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# New challenges for DSOs (and TSOs)

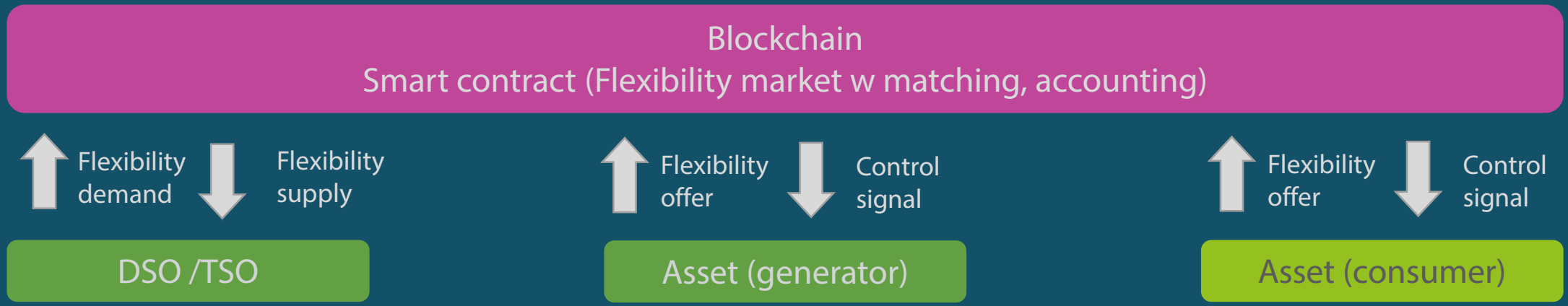
## Grid friendly management of assets

- Growing balancing costs
- Balancing responsible parties are facing increasing volatility in the balancing area due to growing distributed generation, power-to-heat, and e-mobility
- Unused inexpensive potential for distributed flexibility
- Future power system governance requires more responsibilities of consumers, prosumers and distributed generators

# Solution – OLI Balance

## Grid friendly management of assets

- Enable active control of assets through Smart Contracts and corresponding hardware interfaces
- Create local market as a product – specifications can be designed by the operator
- Ensure connectivity and automated bidding
- Include information based on forecasts and spontaneous events

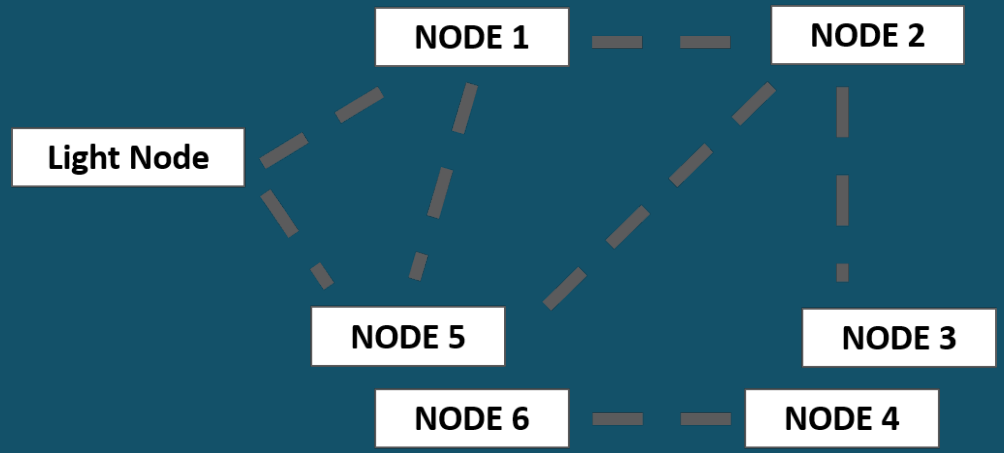


# Required components

## Grid friendly management of assets

- Vivavis blockchain gateway as an interface between blockchain and flexible asset >20 kW
- OLI box for prosumer households with small assets < 20 kW
- Smart Contracts to run local market
- Local bidding agent and control interface towards asset, both embedded in gateway/box
- User interface (web/app)





# Use Case #3: Local Energy Communities

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# Challenges

## Local energy communities

- Self-generation for self-consumption highly competitive, but alternative marketing channels weak

- Increasing number of small distributed generators with only limited access to power markets,
  e.g. 4 GW + of post EEG generation entering German market in 2021

- Phasing out of public support schemes obliges particularly small RE based distributed generators to seek for new ways for marketing their generation

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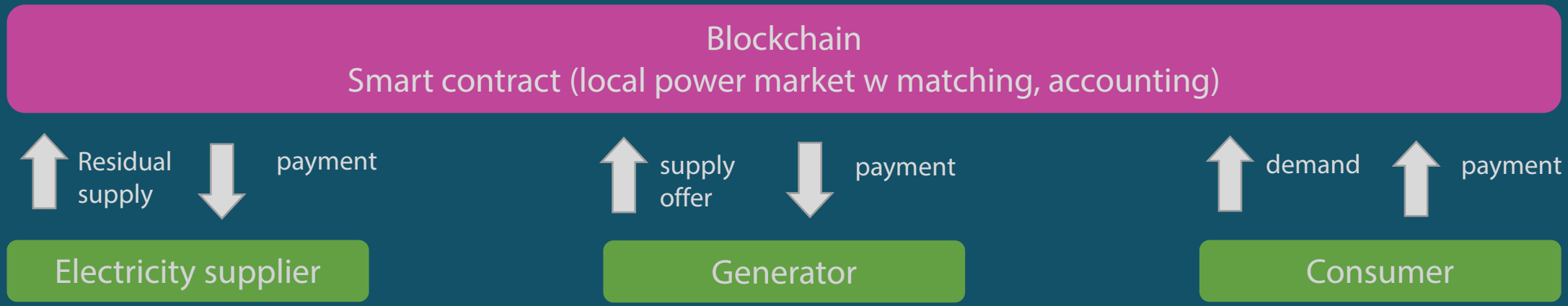
# Solution – OLI Market

## Local energy communities

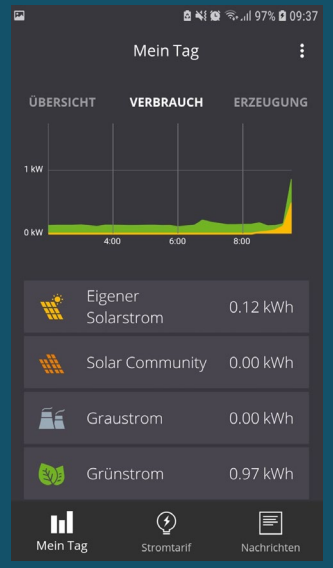
- Enable active control of assets through smart contracts and corresponding hardware interfaces
- Create local market as a product – specifications can be designed by the operator
- Ensure connectivity and bidding functionality for all participants
- Include information based on forecasts and spontaneous events



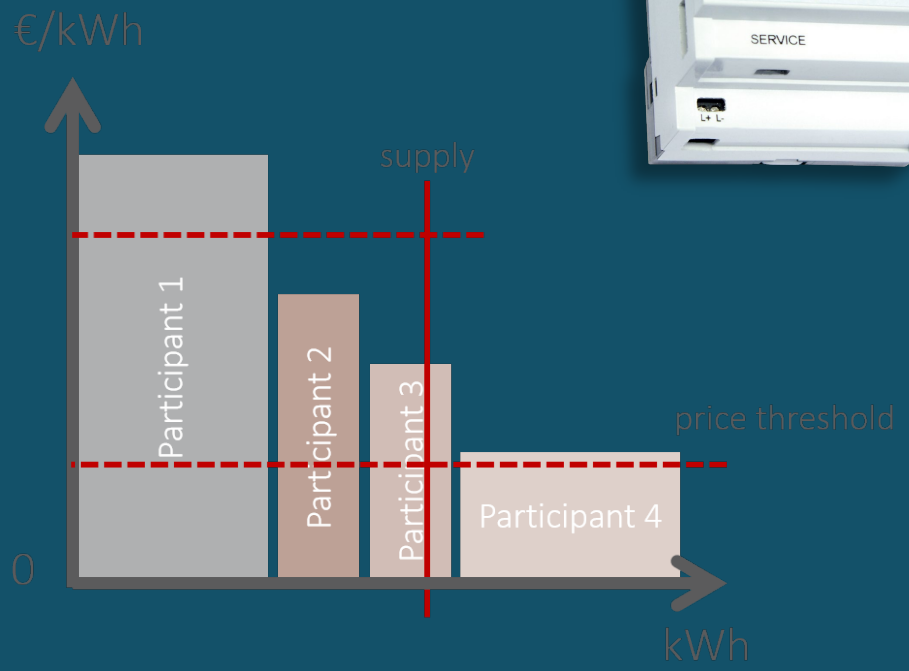
# Required components

## Local energy communities

- Vivavis blockchain gateway as an interface between blockchain and asset >20 kW
- OLI box for prosumer households with small assets < 20 kW
- Smart Contracts to run community market
- Local bidding agent
- Smartphone interface for the user






# Use Case #4: Smart E-Vehicle Charging

# Challenges with E-vehicle charging

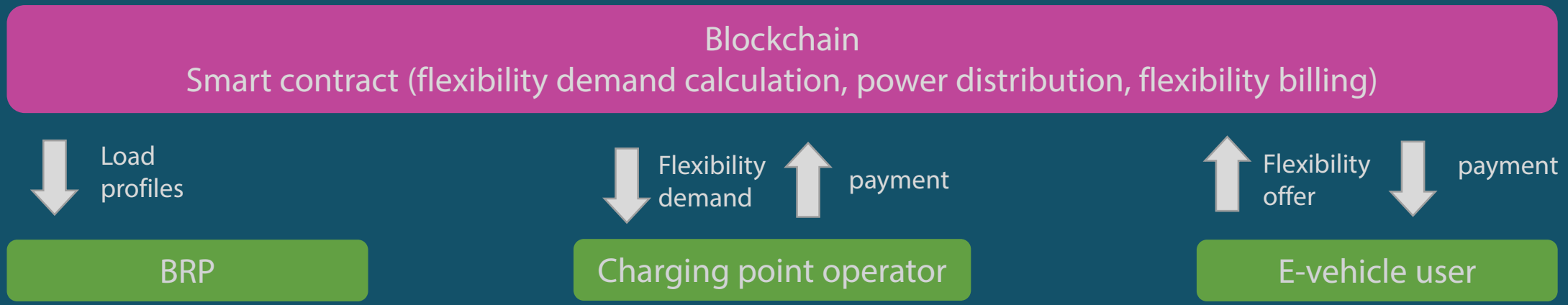
## Smart E-vehicle charging

- Facility operators are  faced with increasing demand for charging points for E-vehicles but have only limited connection capacity to the grid (semi-pubic charging points)
- Limitation in local distribution grid capacity may restrict possibility to install sufficient charging points at hot spots
- Grid operators cannot control charging stations in the same manner as other interruptible loads
- Uncontrolled E-vehicle charging puts stress on balancing responsible party

# Solution - OLI Move

## Smart E-vehicle charging

- Additionally to a usual power supply contract with the charging point operator the E-vehicle user concludes a second contract on flexibility via blockchain
- The E-vehicle user indicates via an App his flexibility by stating required charging load and time of disconnecting from the charging point
- When more E-vehicles are connected to the charging station than maximum allowed load than the charging point operator demands for flexibility. Suppliers of flexibility trade in their flexibility by allowing temporal interruption of charging
- The supplier of flexibility is rewarded with a share on the extra income the charging station is generating through additional charging
- The concept can be extended to a (local) market for flexibility to address grid constraints, intermittent local power generation, or to benefits from price differentials at super-ordinated power markets.



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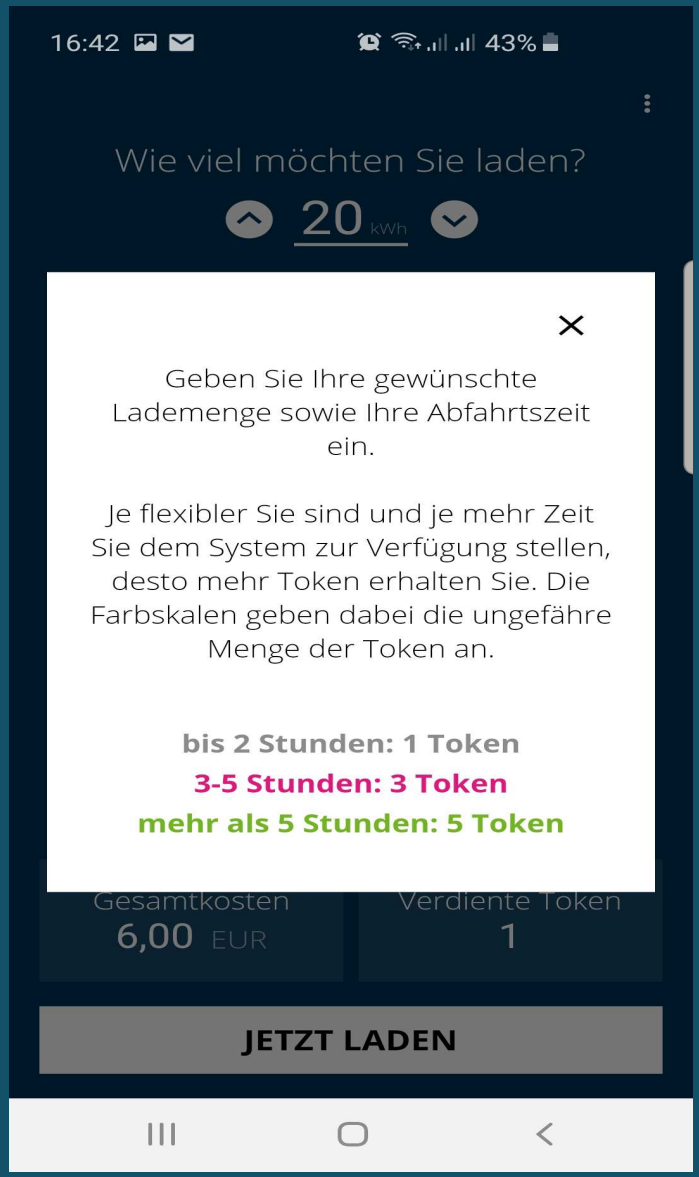
# Required Components

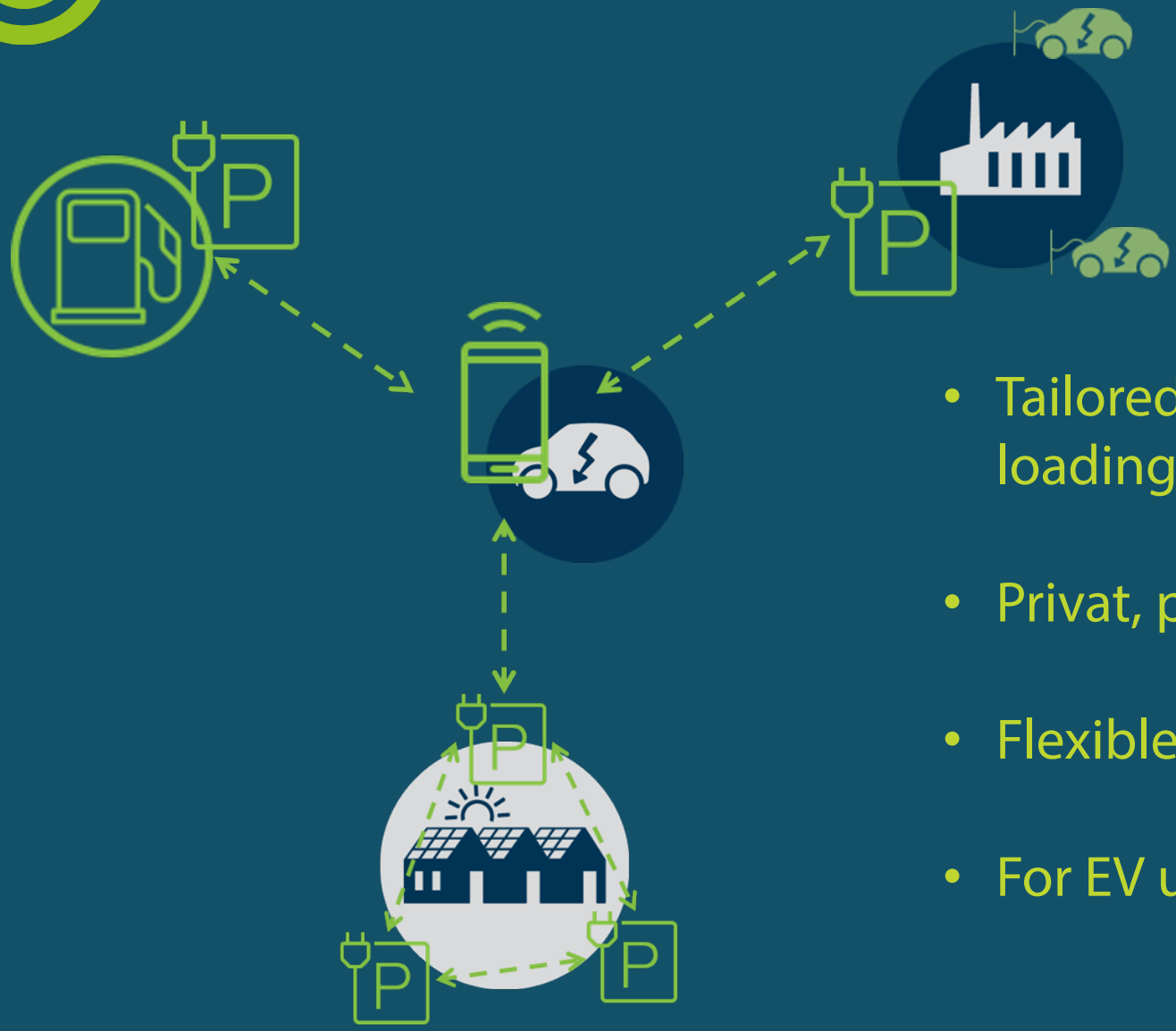
## Smart E-vehicle charging

- OLI Box as an interface between blockchain and charging point (OCPP)
- OCPP ready charging point
- Blockchain backend
- Smartphone interface for the e-vehicle user

# Intelligent Charging in Action

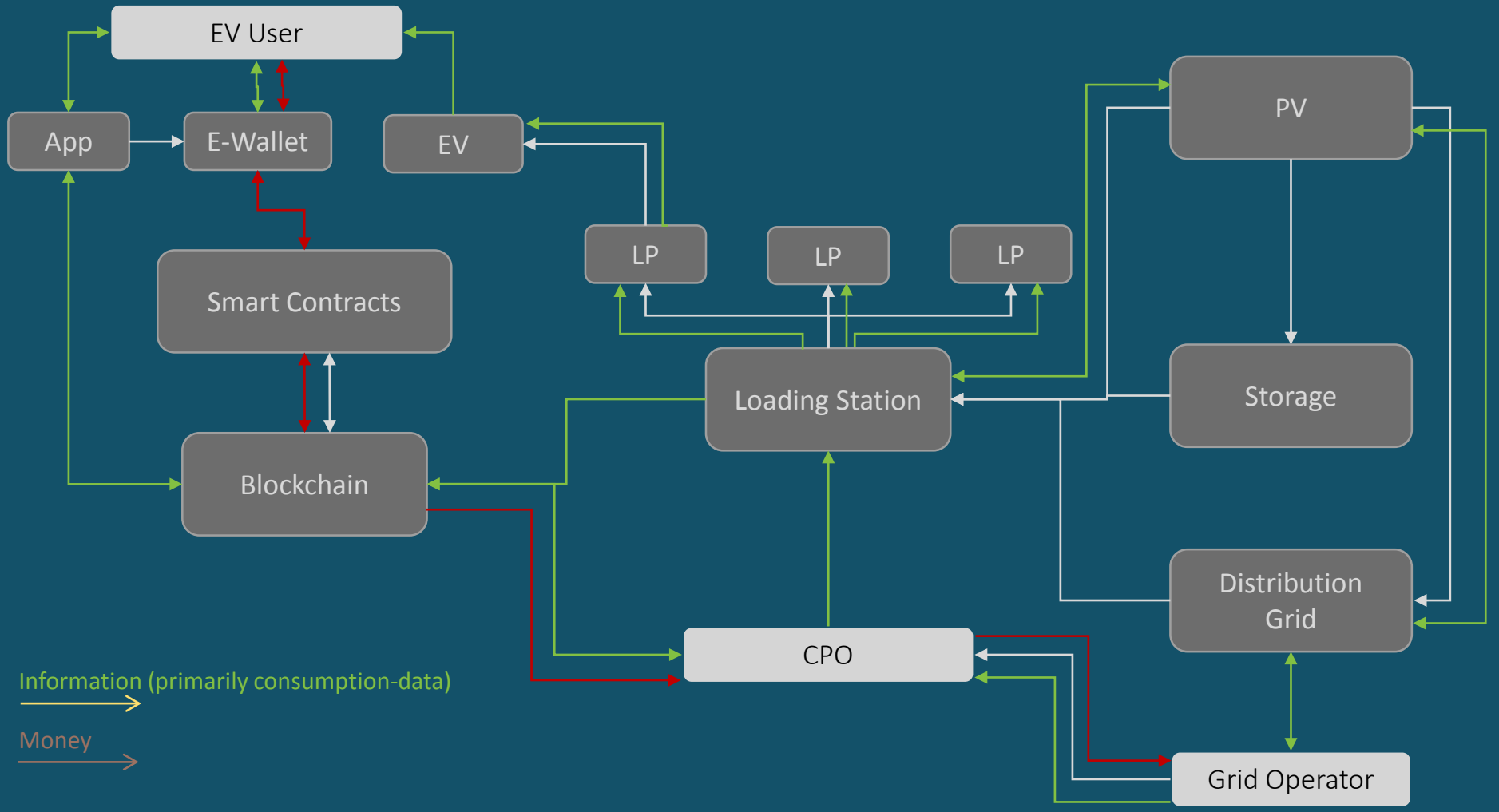
## General Goal



- Tailored to the needs & grid oriented loading
- Privat, public und half-public
- Flexible pricing und unified billing system
- For EV user via smartphone available

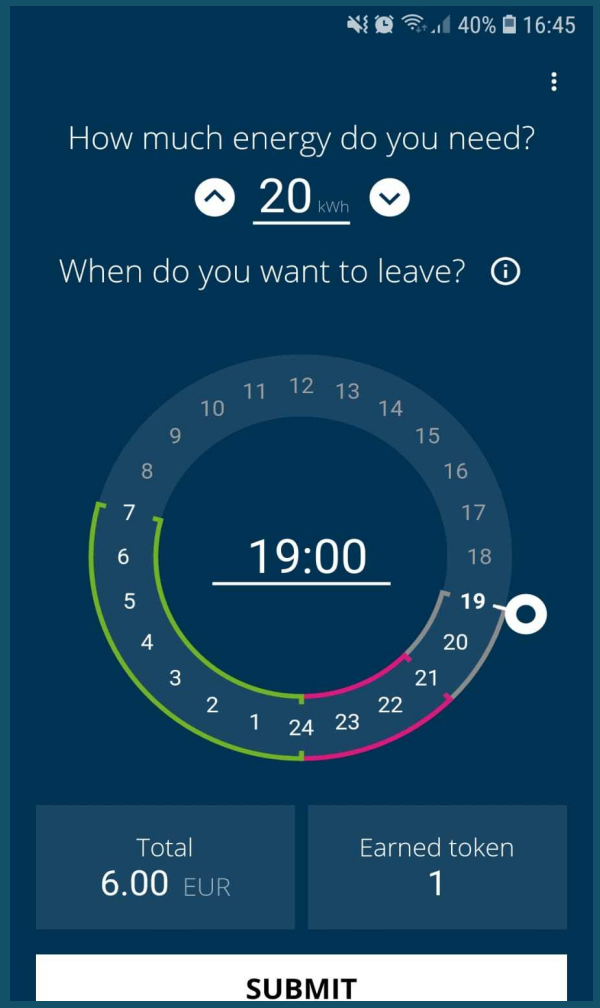
# Organization for Charging

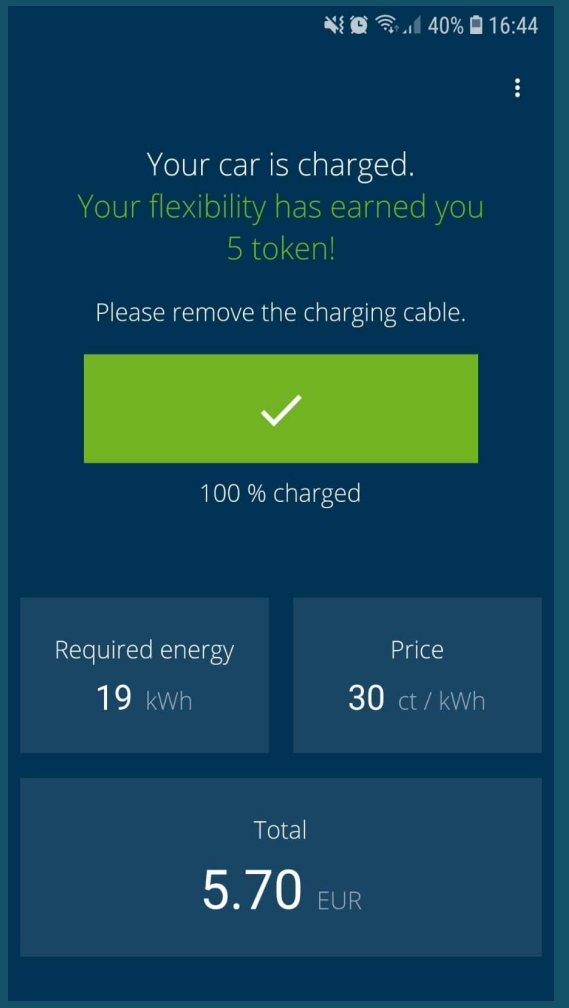
## Akteurs – Assets - Funktionalities



# Rewarding for Charging & Parking
## Conception

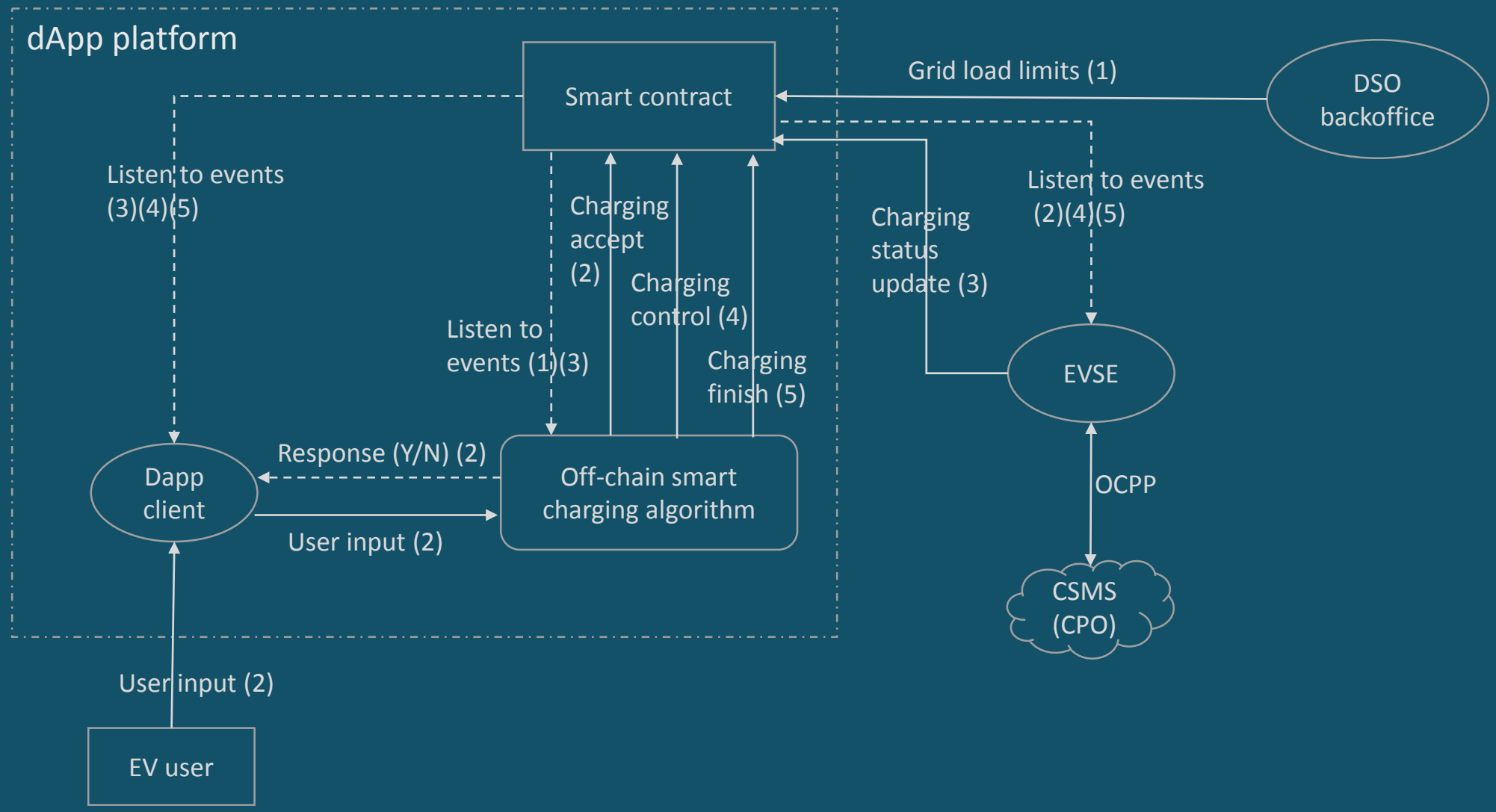
- User gives his loadingpreferences in the App
- Token for App-Using (the earlier the reservation, the more tokens you get)
→ bether planning of timetable)
- Pay per kWh
- Parking tariff (independend of charging)
- Parking also possible without App
- Decent tariff with App



# Smart contract –based EV charging

## Communication diagram



# Tokenisation of (Energy)-Services

# A Bonus-System for Sustainability

Integration of the User through the Smartphone in the Smart City-Community

- Sustainable dealing on a individual level is getting rewarded
- Tokens are used as bonus for all kinds of sustainable activities
- Tokens are cashless payments in a quarter via a district-app
- Tokens can be exchanged and redeemed via a smartphone (NFC/QR)

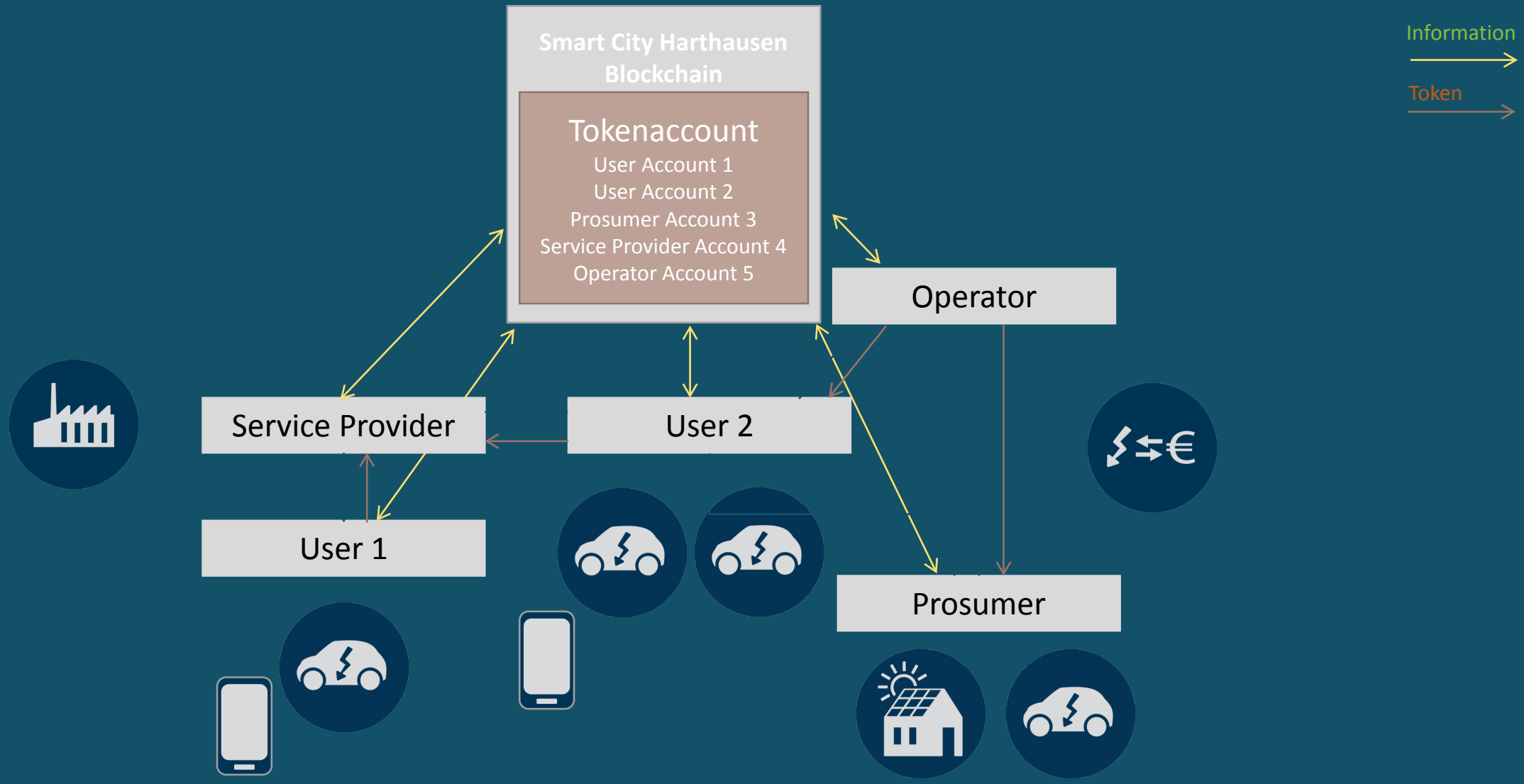
# Which User Behaviour should be rewarded?

User, Service-Provider and CPO profit from this

- User acts very flexible for charging his/her EV
- User is actively using alternatives for mobility
- Prosument sells energy to CPO (via PV or EV)
- Service Provider is offering discounts in terms of tokens (rewarding-models)
- User is taking those discounts from the service provider
- Operator is giving tokens e.g. for a lower heating- and energy demand (appartments)
- Operator is charging tokens for heating-, energy- and chargingcosts to the user

# Systemarchitectur of a Quartertokensystem

## Akteurs – Assets - Funktionalities



# Milestones and Prospects

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## Customer & Projects

**DOSE**
Energy Management

Lutricity Microgrid

Allgäu Microgrid

Post EEG local markets

**Nuklib smart charging**

Guarantee of origin

**Flexichain**
Market coupling

**Blockclass**
Blockchain standards

**develoPPP GIZ**
Future Energy Lab

2016 2017 2018 2019 2020 2021 2022

## Technologies

OLI Box

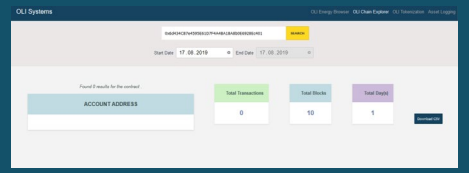
OLI App

Industry grade
BC gateway

Energy Web
validator node

**Daklib**
Balance group management

OLI energy browser
www.oli-chain.org



OLI Chain explorer

Smart
charger

# Re-thinking energy transition

## OLI in a nutshell (August 2019)

- Established 2016 in Stuttgart, Germany, currently 10 employees
- „Blockchain-as-a-Service for the energy sector“
- Pilots with several utilities conducted
- Awarded /commissioned projects 700 k€
- Proposal pipeline 3 million €
- 10 full-time employees
- Comprehensive cooperation network and technology partnerships
- Internal investments and contributions ca.  750 k€
- External investor with 500 k€ in Jan 2019

Associated partner

Affiliate and validator

Member

# Key personal

Peter Vogel, born 1969, investor and CEO,
4th generation family entrepreneur

- Solar power plants in Italy and Germany
- Amazon European car spare parts trade
- Car workshop franchise  in China

Dr. Ole Langniß, born 1965,
strategy and CEO

- Energy transition pioneer
- Energy policy adisor world-wide
- Smart Grids project developer

C sells

Das Energiesystem der Zukunft


Dr. Thomas Brenner,
born 1983, CTO

- PhD in Cambidge on organic PV
- Reseacrh group leader in Potsdam till 2015

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Swiss Federal Institute of Technology Zurich

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für die Physik des Lichts

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