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Blockchain as enabler for transactive grids

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The energy systems are changing dramatically

From monopoly power …


… to energy democracy.


From downstream power delivery …

… to smart distribution and bidirectional power flows.

From top-down topologies …


… to decentralized local structures.

From predictable long-term value streams …

… to versatile, short-term transactions.

A future energy system must enable autonomous operation of millions of active assets!

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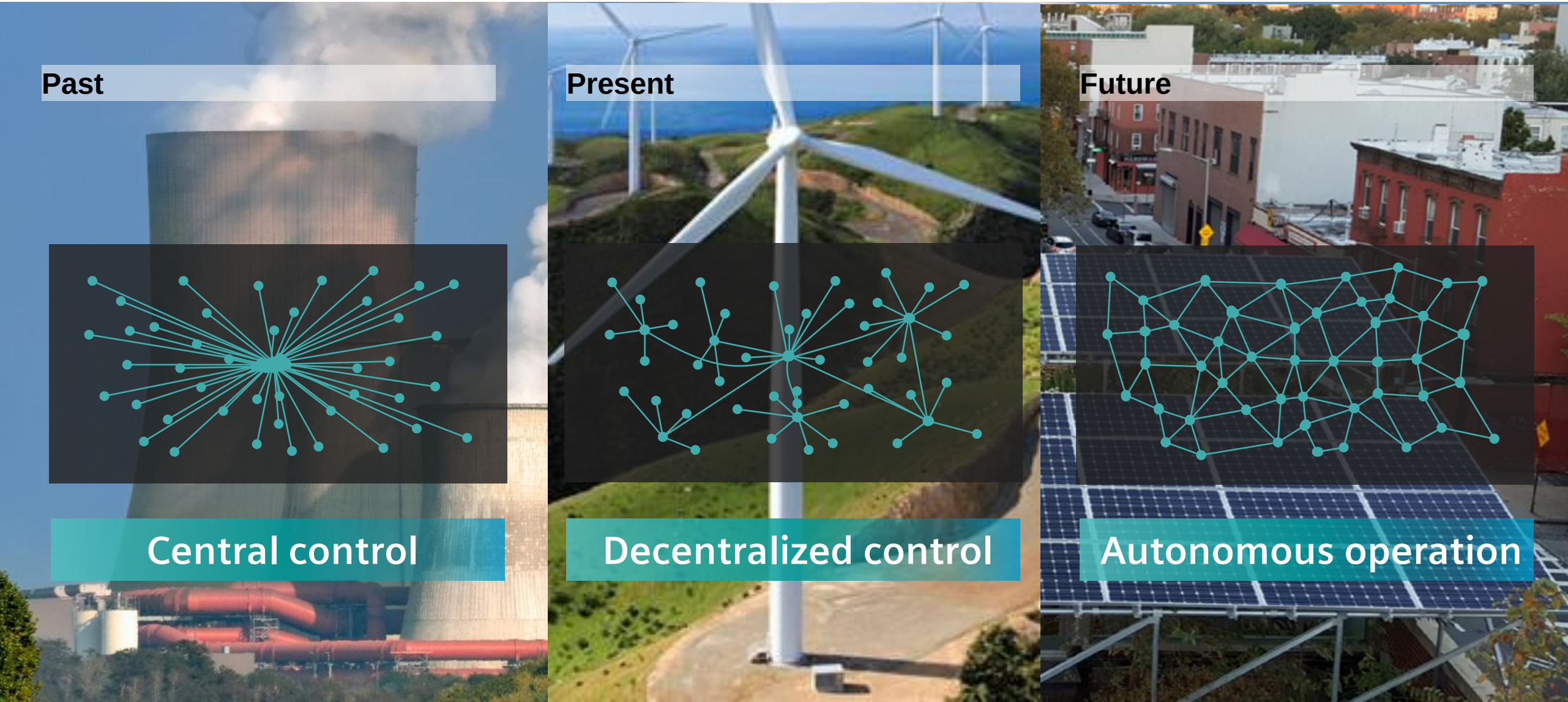
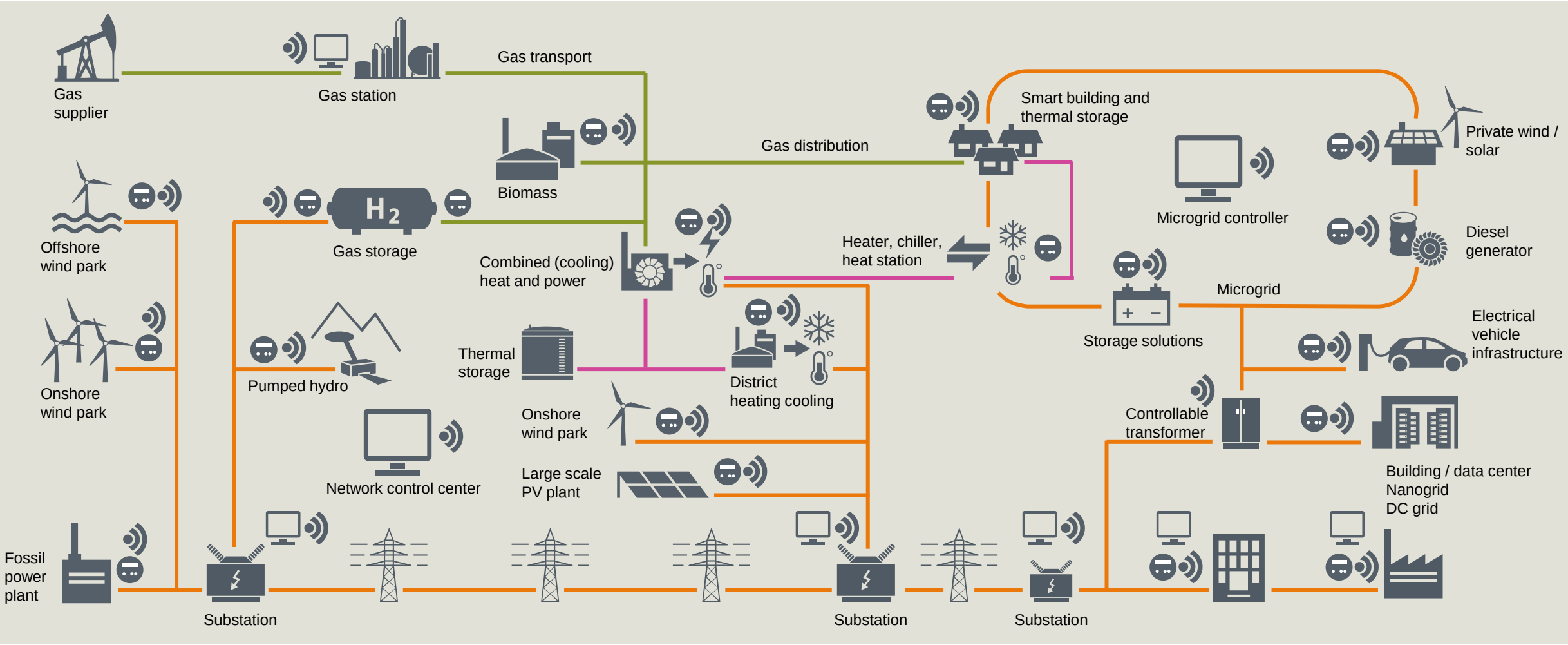


Future Energy System



Our proposal: a transactive energy system …

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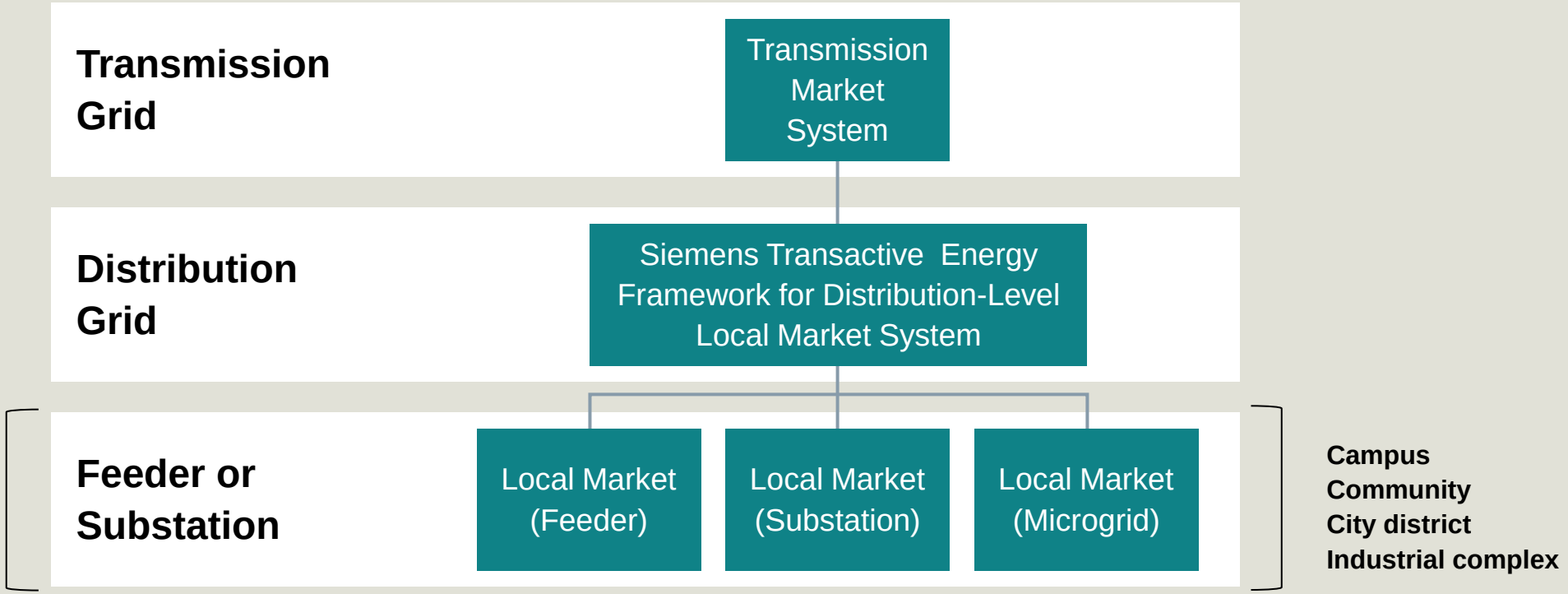
Siemens' Transactive Energy System Approach
3-layer Market Structure



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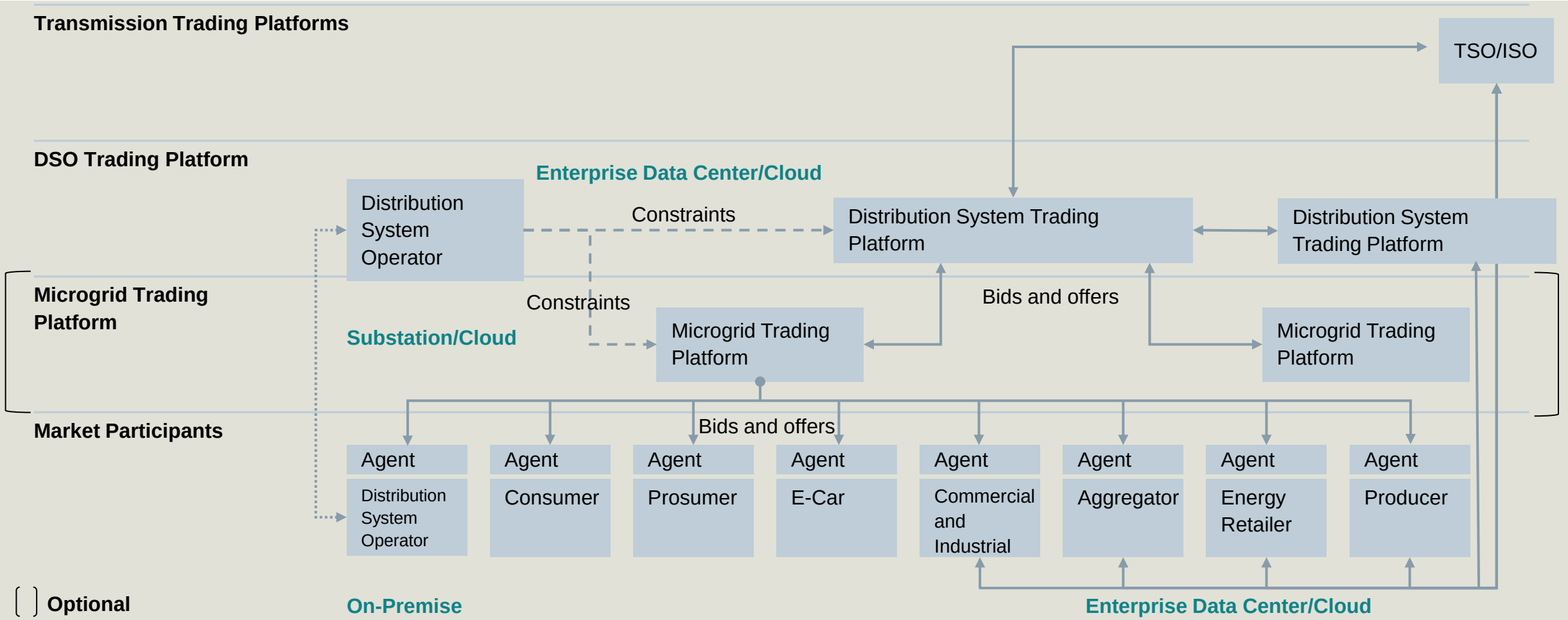
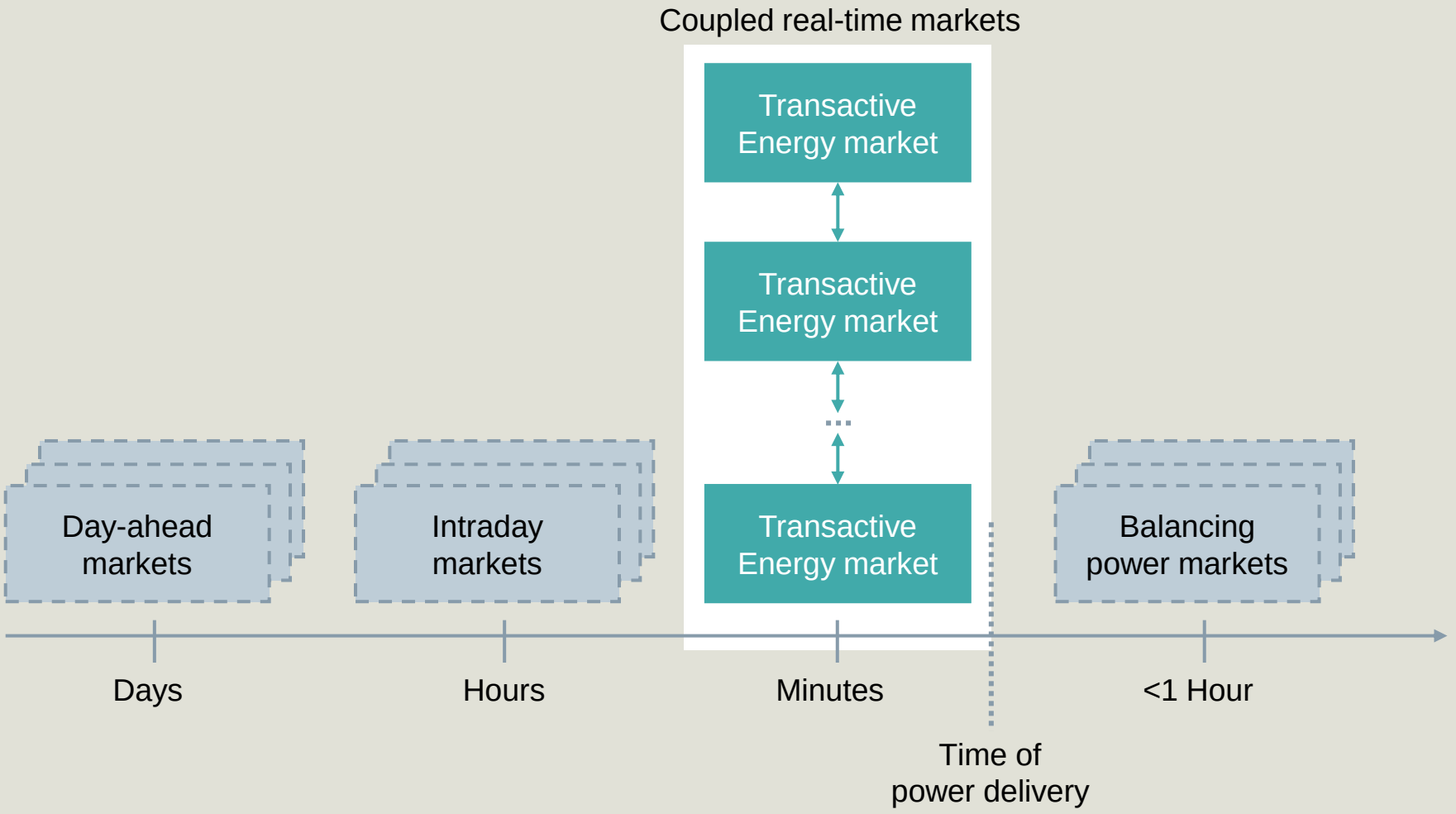
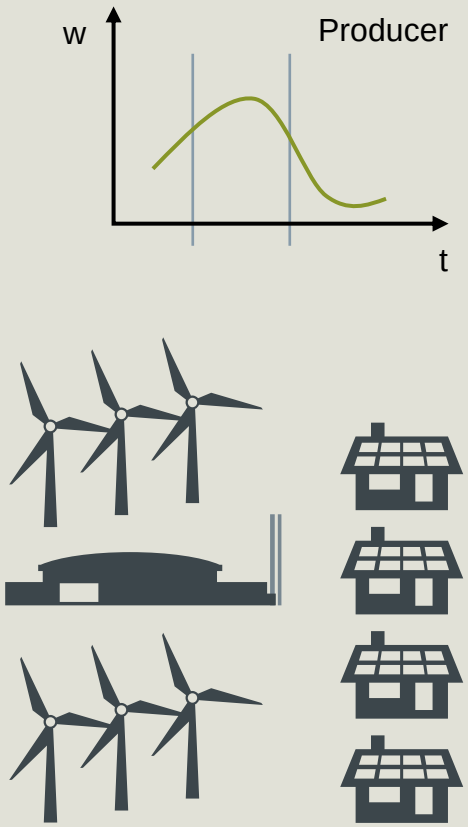
Energy landscape within the transactive energy system

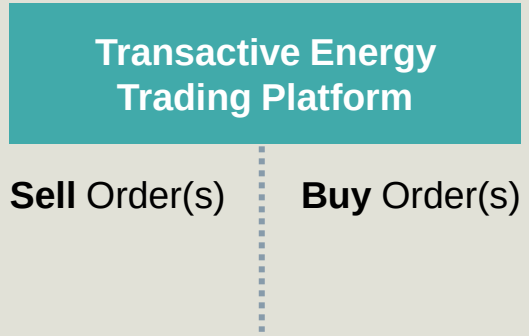


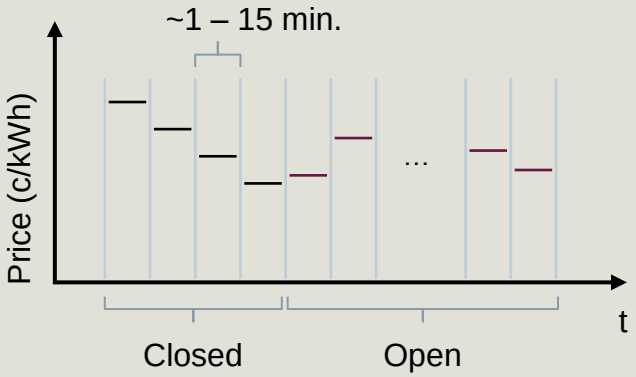
Integration of transactive energy markets as a balancing option in a first step

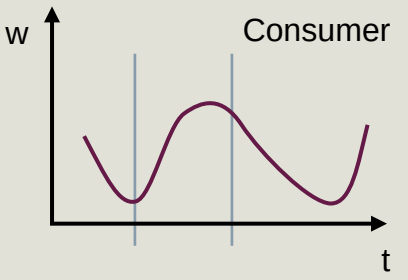


Principle of the Trading Platform









- dynamic pricing
- double-sided auctions based on a series of overlapping trading time intervals (time-slots)
- Dynamic time-slots (1 to 15 minutes)
- different trading categories with respect to the delivery quality

Blockchain and associated smart contract technology offers key functionalities required for transactive energy systems

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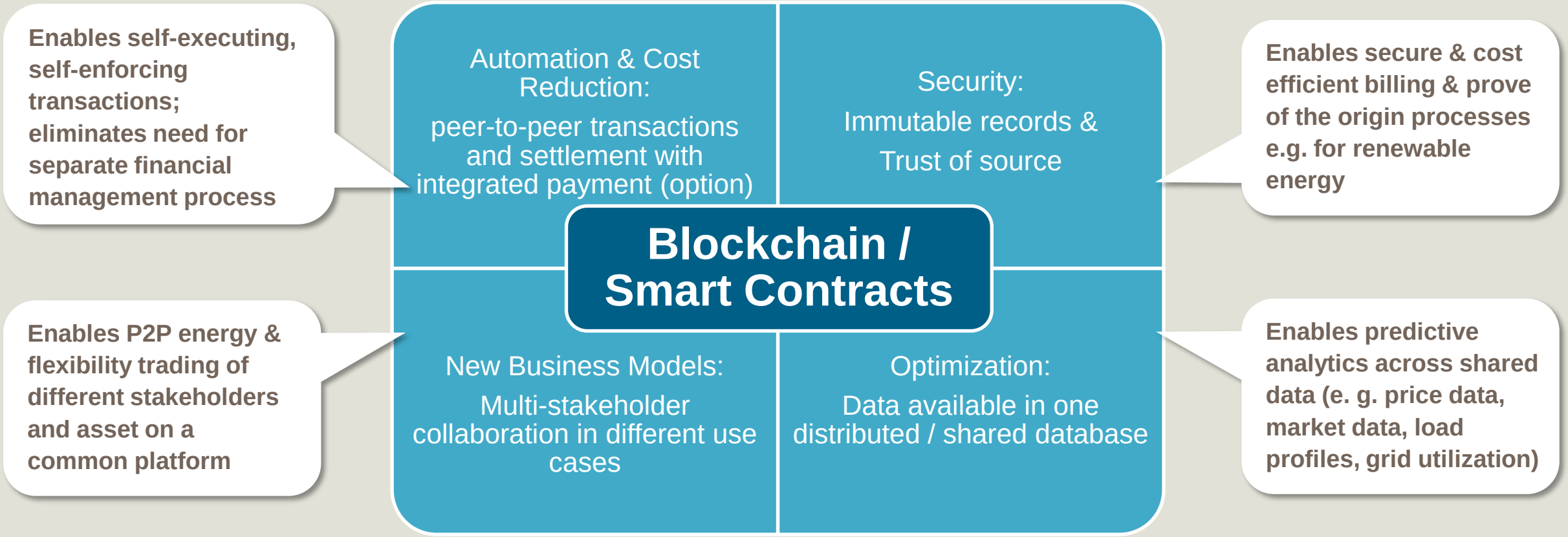
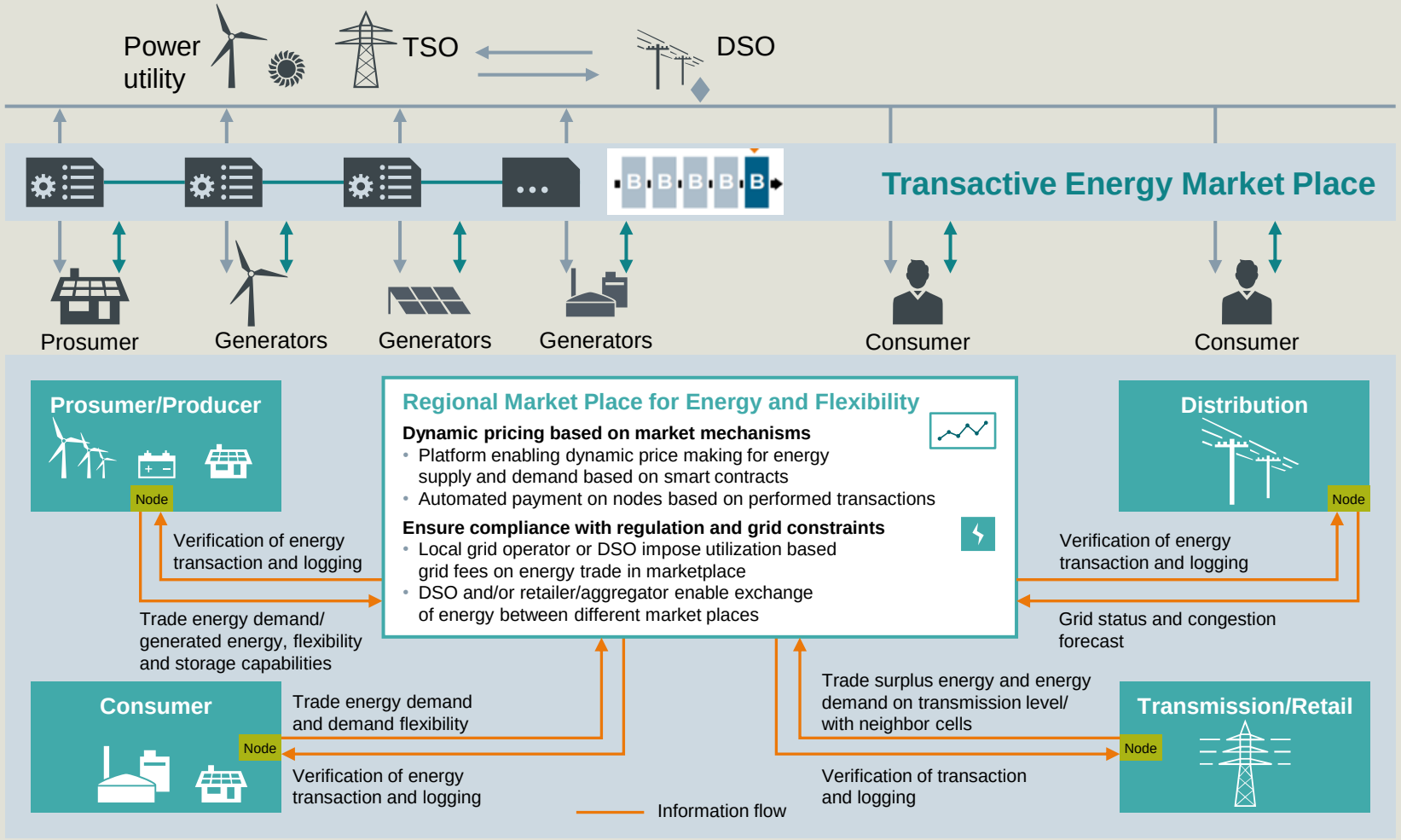


Distribution Grid Level:
P2P energy trading of energy & flexibility within a local market



Feeder or Substation Level: Example Brooklyn Microgrid

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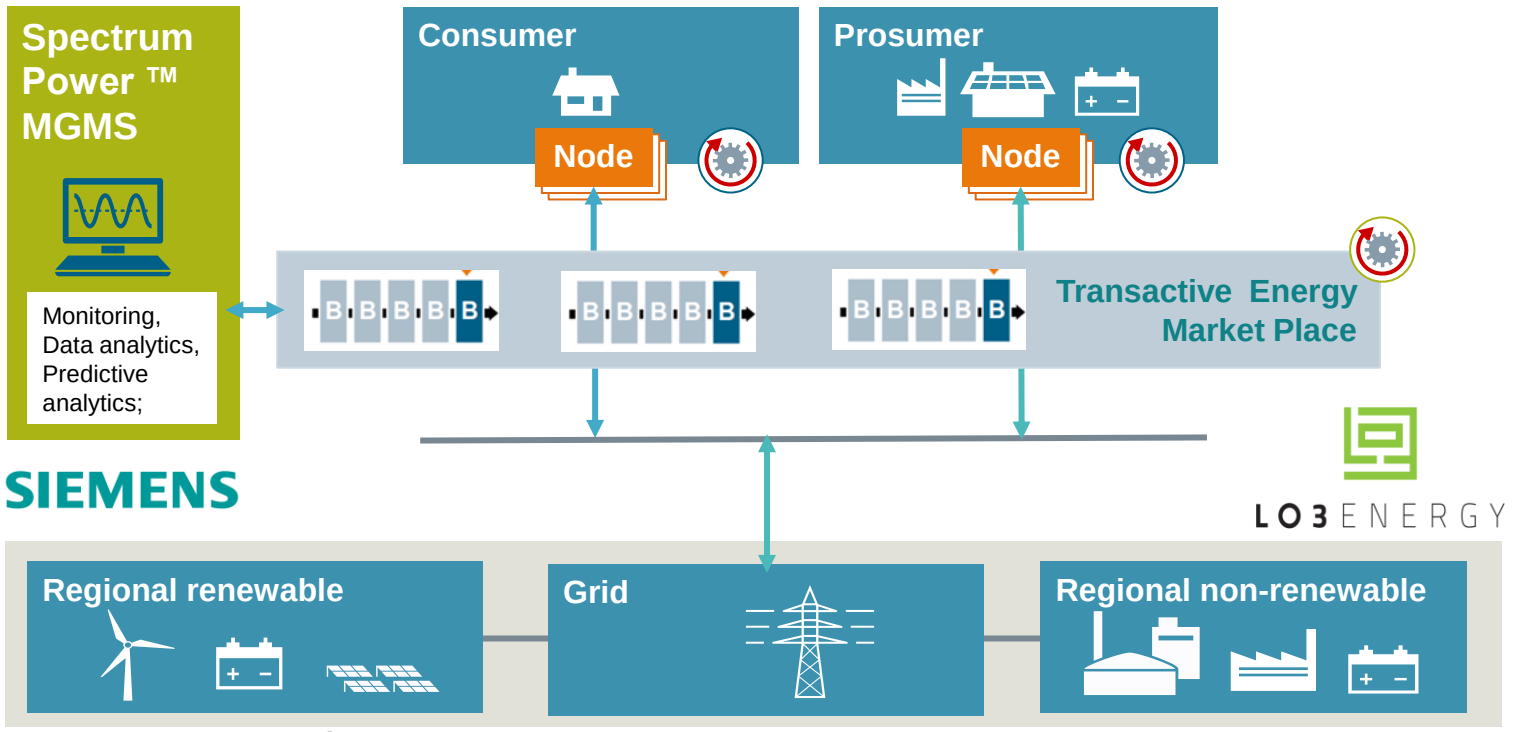
Virtual Microgrid enabling energy trading between community members



Transactive Grid & Smart Meter enables:
- Solar surplus & consumption tokenized;
- Surplus & Flexibility traded in Community Energy Market;

Consumers and prosumers can decide which sources to buy energy from (e. g. local PV, local CHP, regional Wind, natural gas, coal, etc.)

Consumers get the opportunity to earn rewards for negawats they do not consume during certain high peak times

Operator will be able to track energy flow within virtual microgrid, interchange with external grid and to predict future energy flows

Feeder or Substation Level
With island mode capability for increased resiliency

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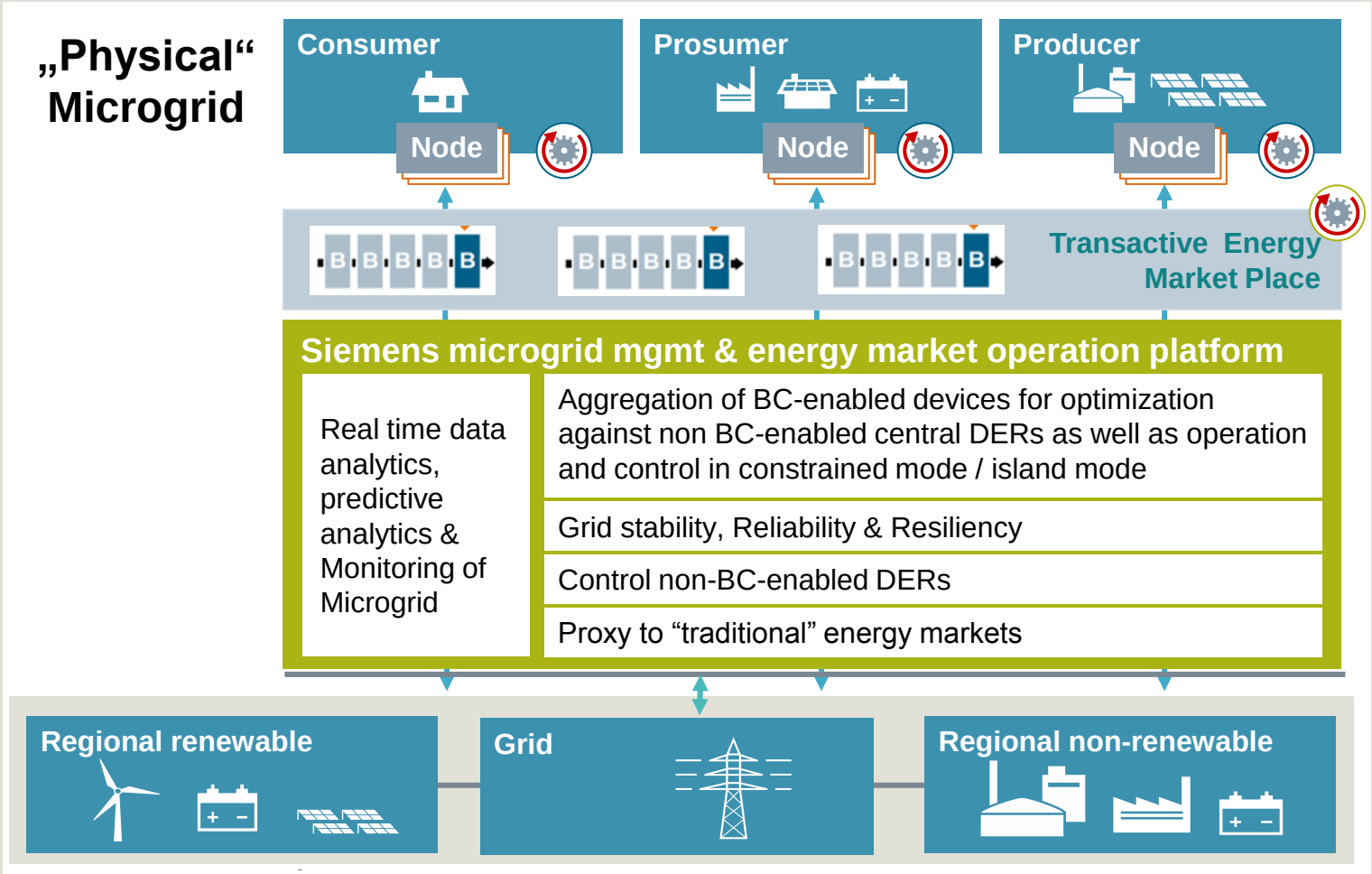

Local market operation Eco-System will enable island mode operation of isolated microgrids during black out of main grid

Increased Resiliency

Vision: integrated ecosystem for regional transactive energy trading and optimized grid control (VDE: “Zellularer Ansatz”)

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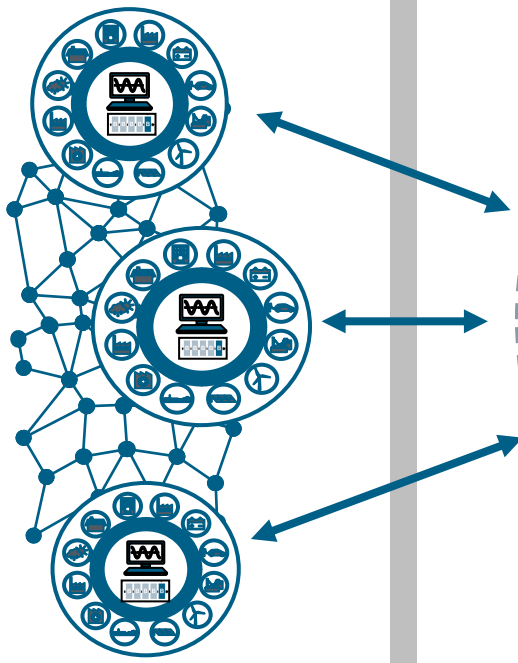
Adjacent Market Places



Regional Transactive Energy Trading

Enabling

- Maximum grid efficiency by optimizing power flows through location value based pricing
- Minimum capacity requirement through demand response
- Increased Resiliency
- Consumers to make more informed energy choices
- Sustainable and affordable energy supply

Advantages of using blockchain & smart contracts

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- Automation of trading processes (self executing smart contracts)
- Cost efficient trading of energy and flexibility even from small prosumers and consumers
- Reduction of complexity and cost of clearing / settlement / billing
- Support of nodal pricing mechanisms (variable grid fees, congestion management) based on spatial location data
- Increased accuracy of forecasts based on transparent market data
- Cost efficient proof of origin of energy (e. g. for green power certificates)

Video

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Innovative Transactive Energy Microgrid Solution power by Siemens

https://player.vimeo.com/video/228443955

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