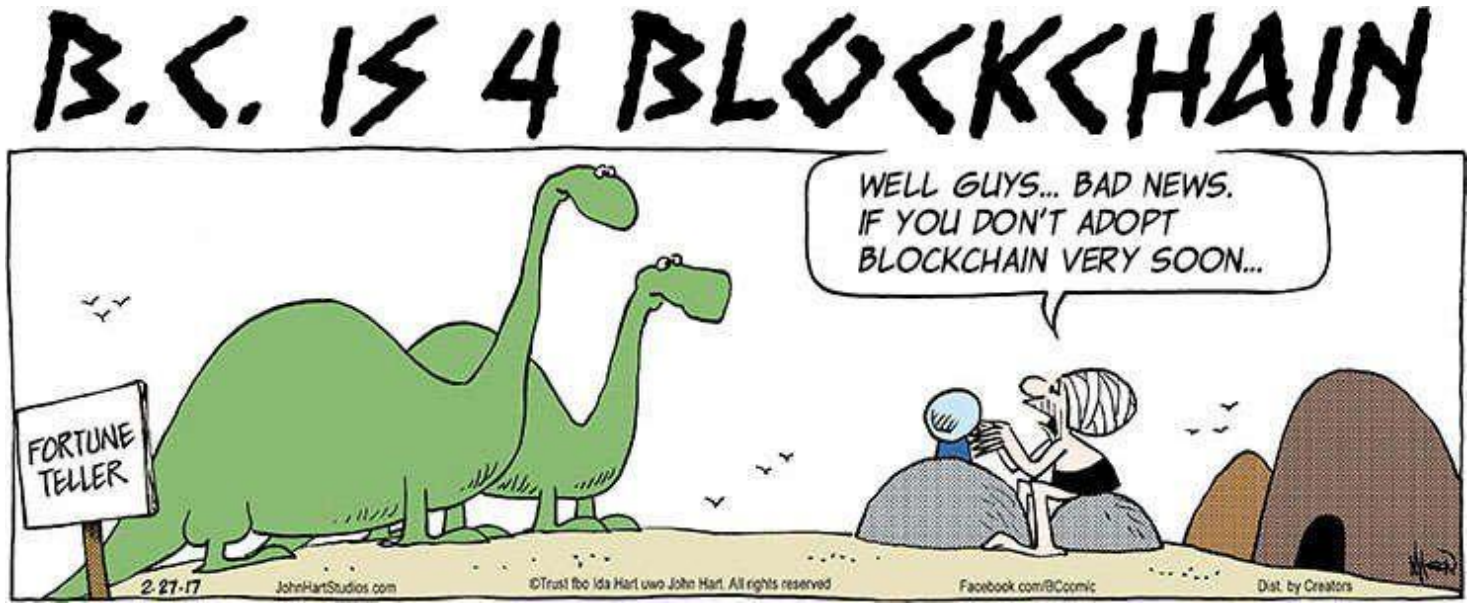
Smart Contracts for Smart Grid:

Harnessing the Potential of Blockchain Technology for Future Energy Systems

BenJeMar-Hope Flores
floresbenjie@seoultech.ac.kr
Asia Clean Energy Forum 2018
ADB, June 4-8, 2018

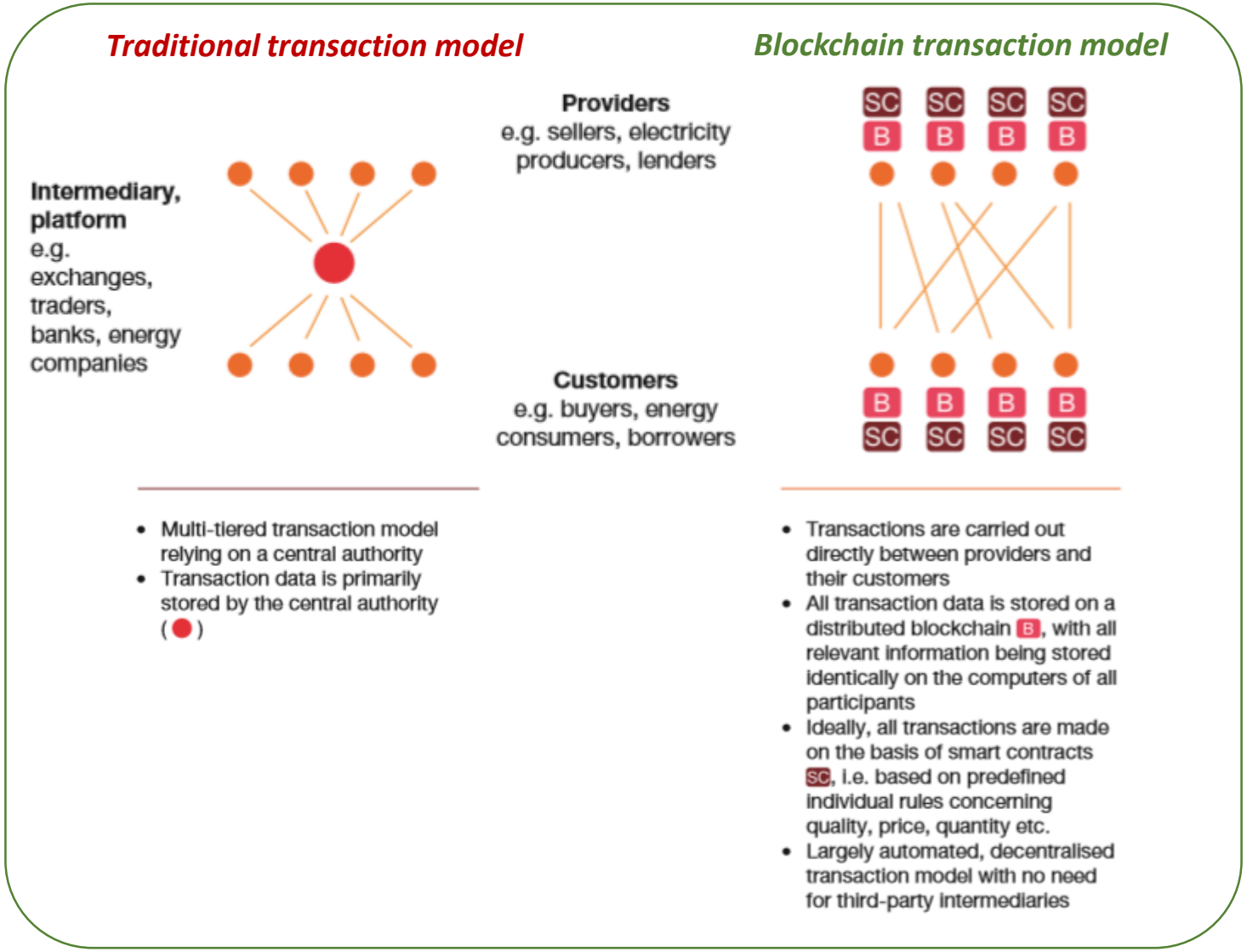
서울과학기술대학교
SEOULTECH Seoul National University of Science & Technology

계통해석제어연구실
Power System Analysis and Control Laboratory



Source: JohnHartStudios

Blockchain basics



Source: Sachs Insights, PwC

Development history:

Blockchain 1.0

- comprises virtual (crypto)currencies such as **Bitcoin** that can be used as an alternative to real currencies.

Blockchain 2.0

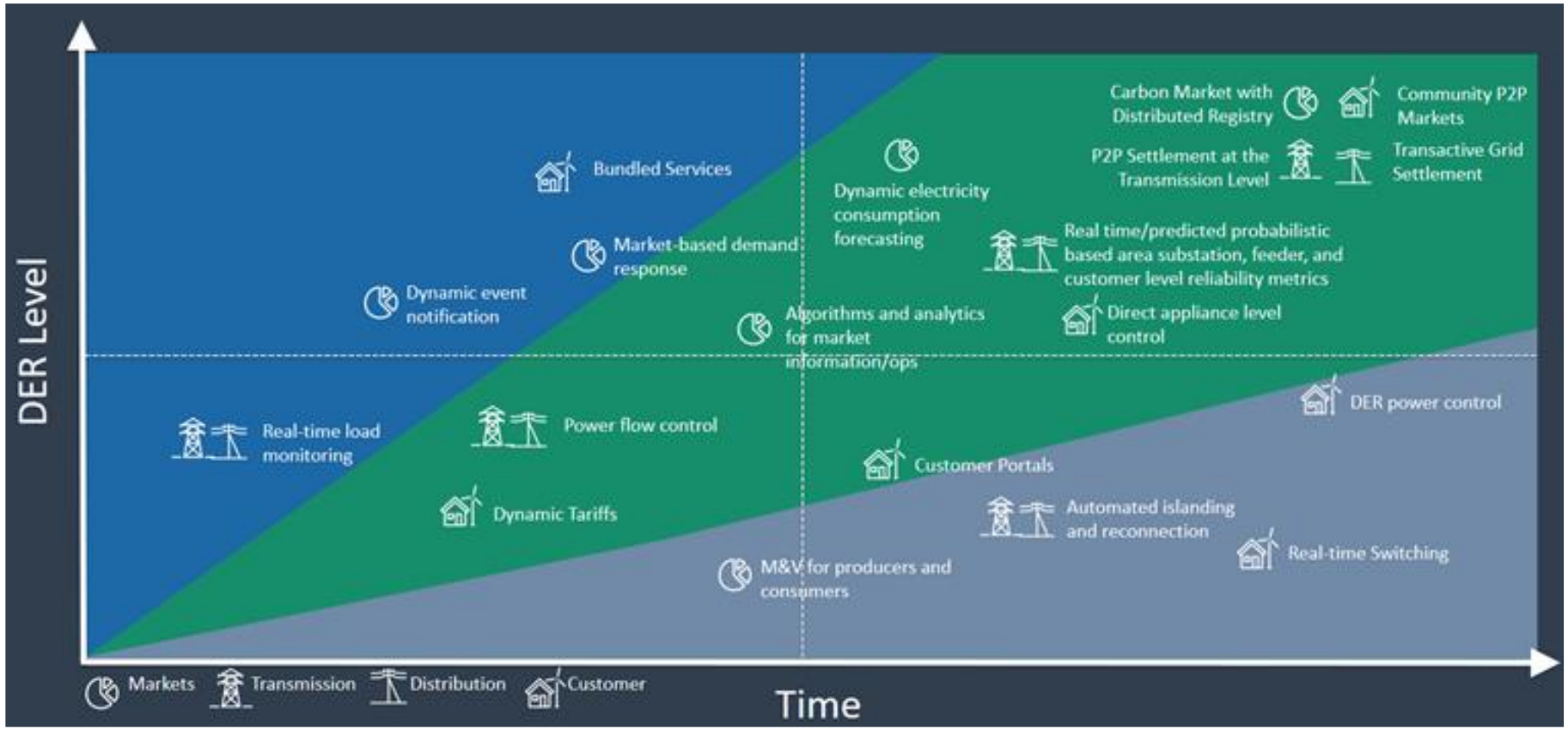
- developments to enable ***Smart Contract*** models
- Smart contracts in energy are fully automated contract between an energy producer and a consumer that autonomously and securely regulates both supply and payment

Blockchain 3.0

- advanced smart contract models that can create decentralised autonomous organisational units that rely on their own laws and operate with a high degree of autonomy.

Blockchain in the energy industry

Transactive and Dynamic Systems



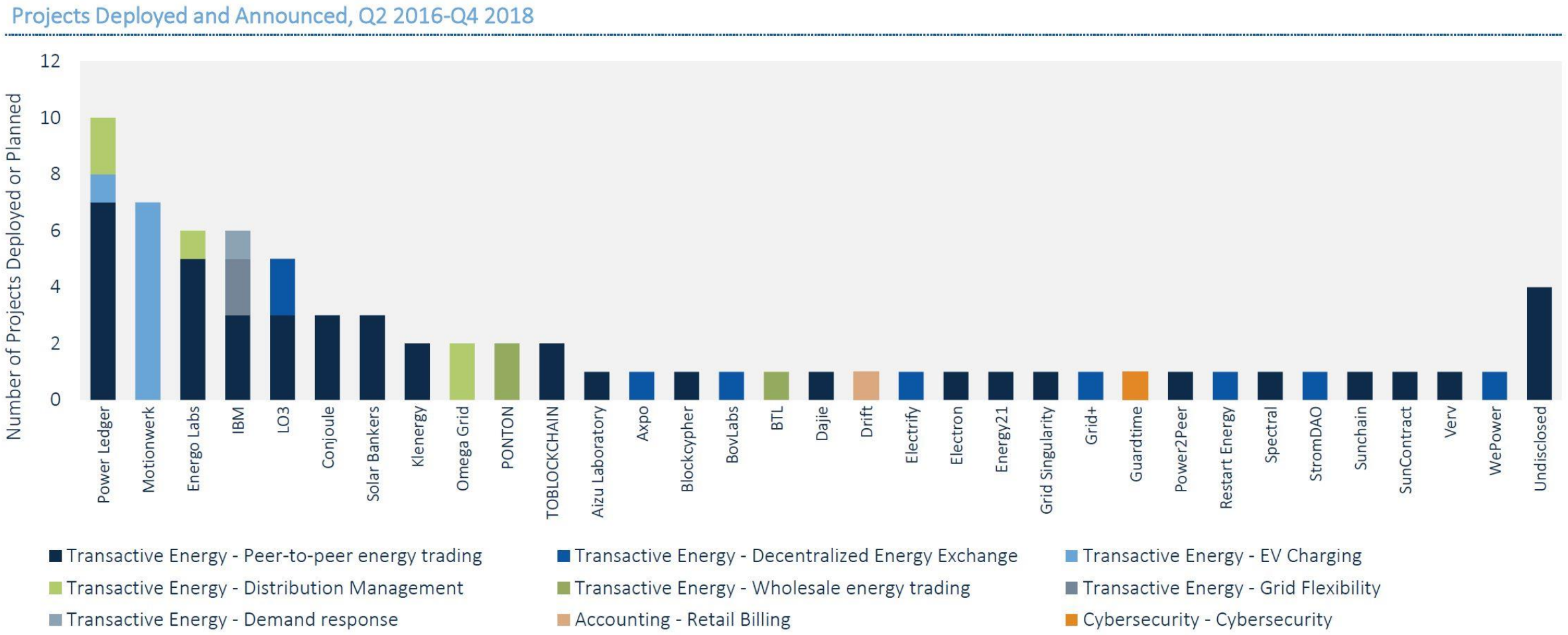
Source: Indigo

*DER – Distributed Energy Resources
*P2P – Peer-to-peer

Blockchain in the energy industry

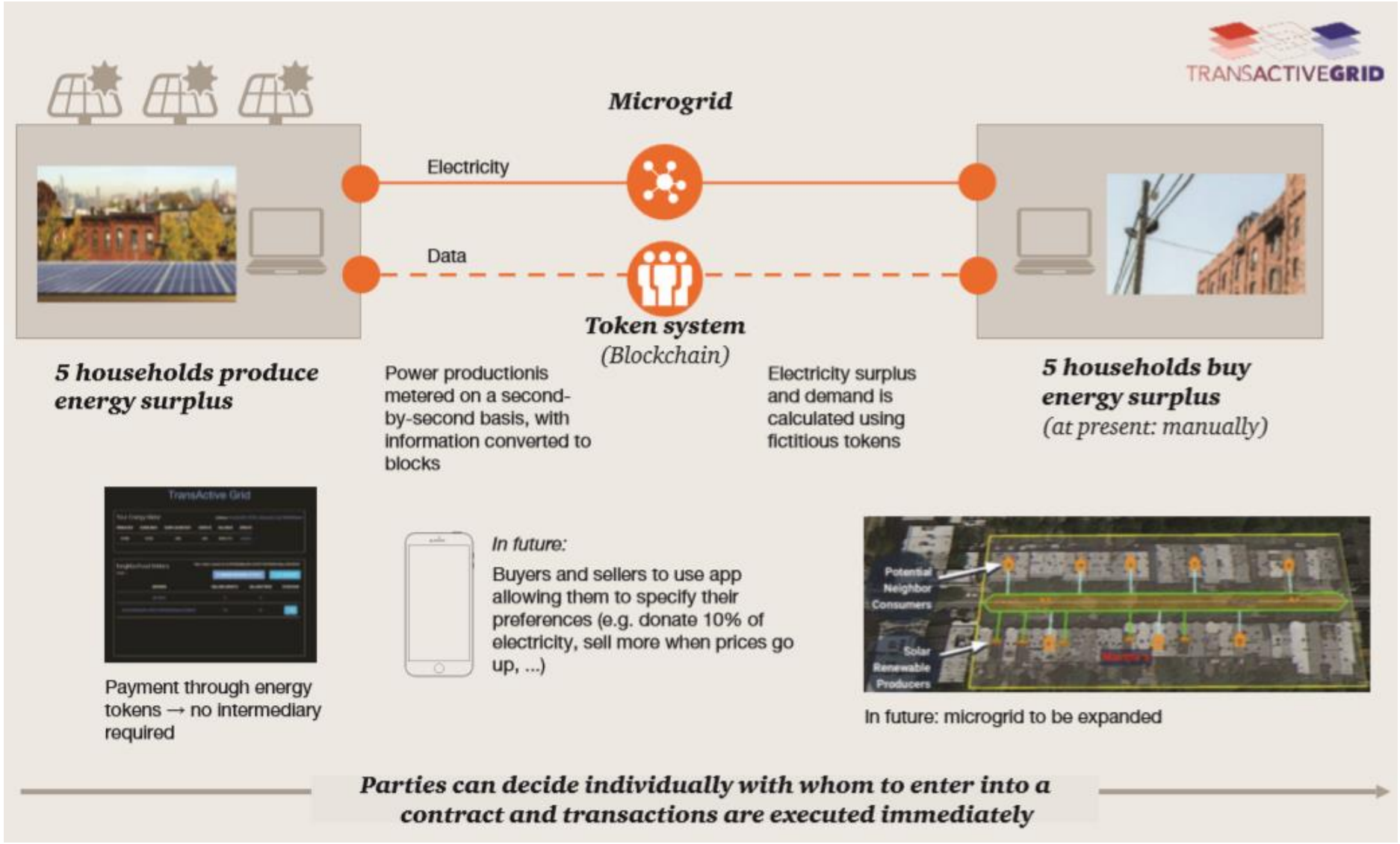
Source: Indigo

Blockchain in the energy industry



Source: GTM Research

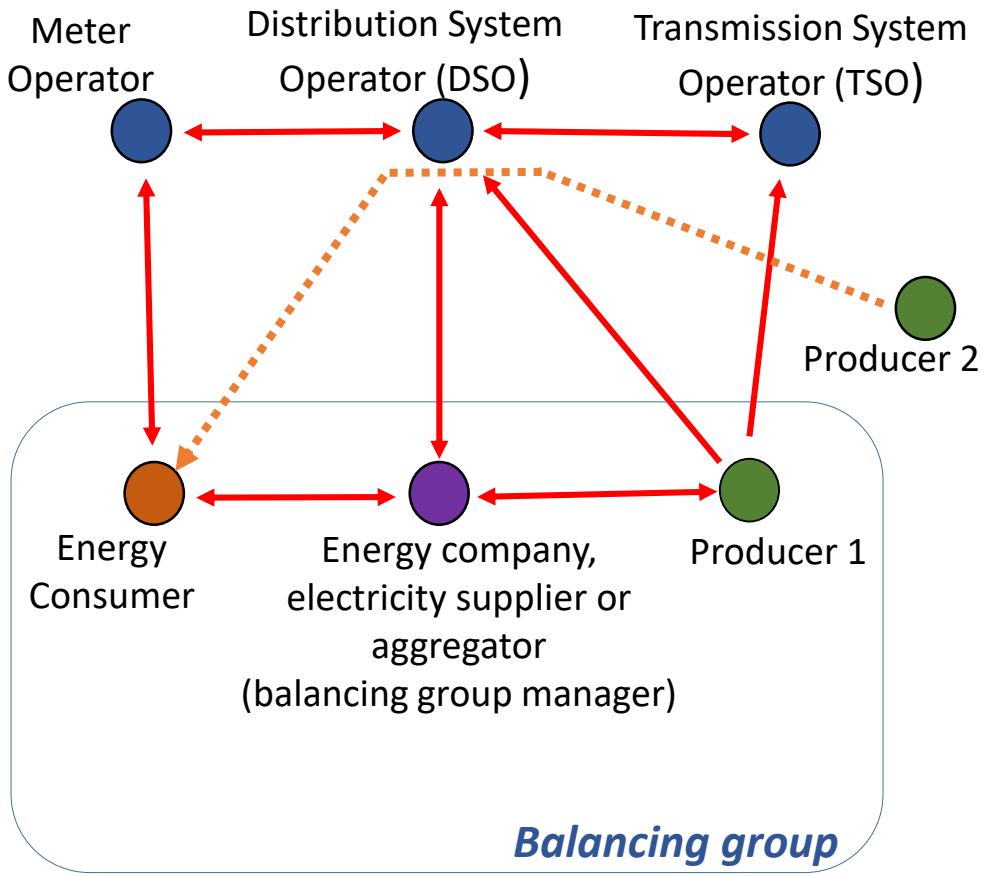
Brooklyn Microgrid



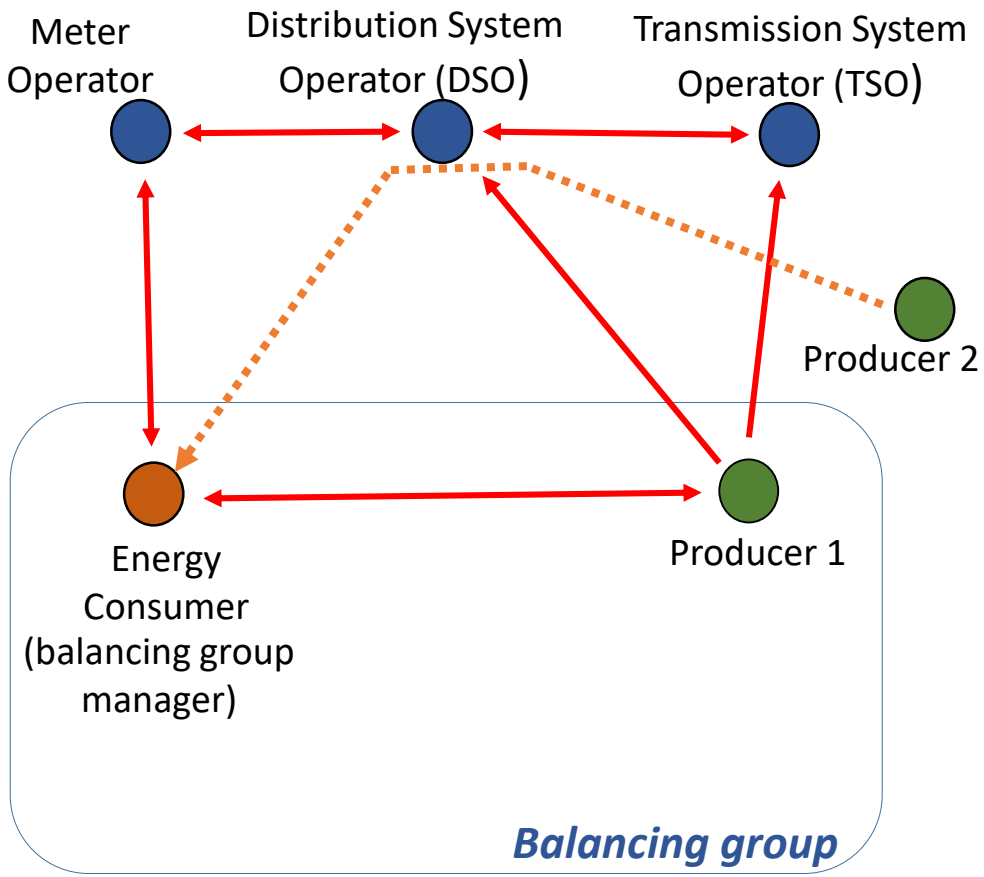
Source: Exergy

New Market Roles

Current market roles



Market roles under a decentralized transaction model (blockchain-based)



Contracts, data flow

Electricity

Transactive Issues

- System control vs transactional exchange – The time domains required to utilize transactive energy for system control applications are typically too short to utilize blockchain effectively. (Exchange of energy in relatively large blocks can be accomplished because there is sufficient time to buffer and process.)
- Lack of standardized interoperability protocols
- Rigidity of jurisdictional regulation (siloed technology)

Consumer Perspective

OPPORTUNITIES:

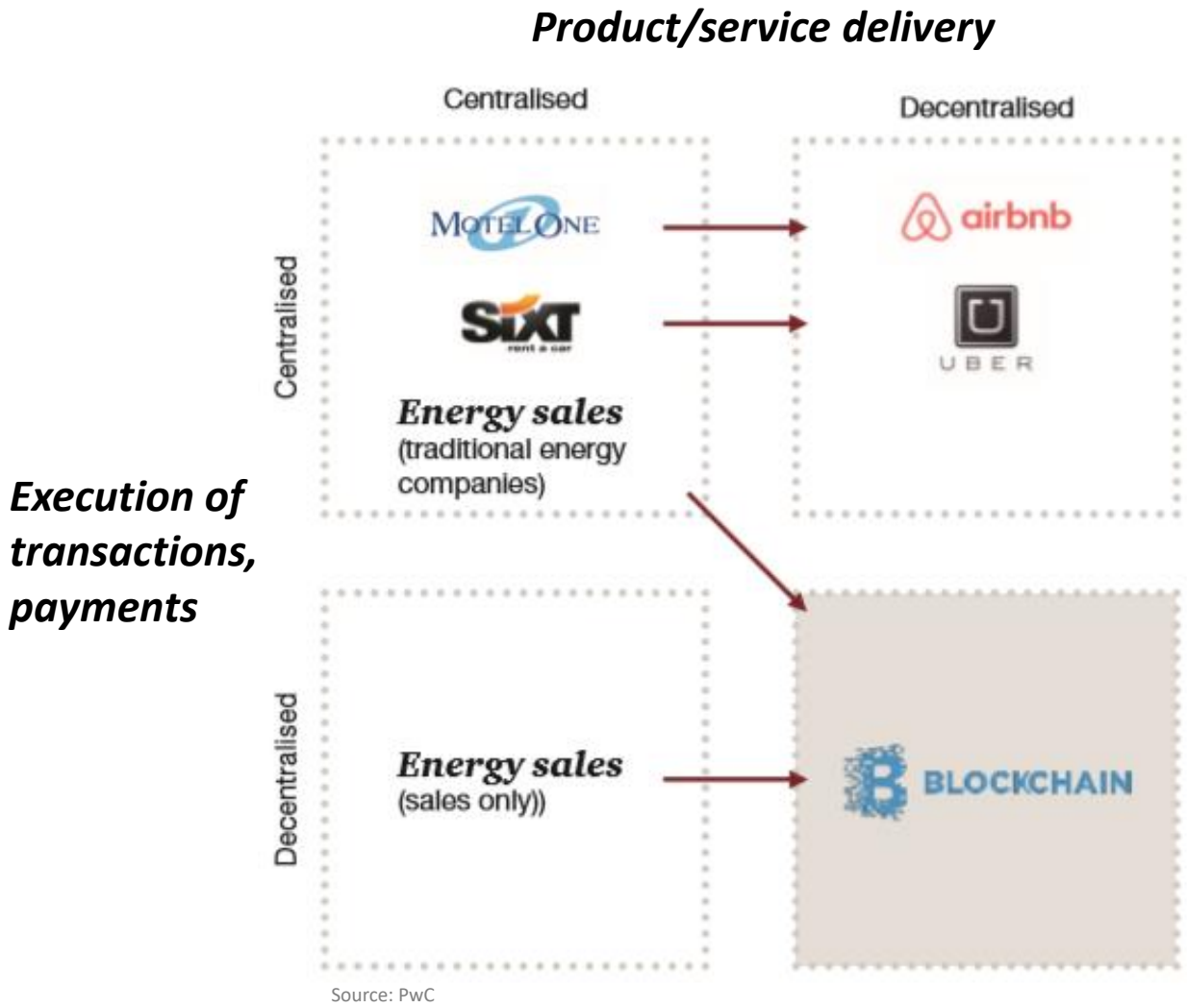
- **Lower transaction costs** due to the cutting out of intermediaries
- **Falling prices** as a result of greater market transparency
- **Greater transparency** thanks to decentralized data storage
- **Simple option** for customers to become a service/electricity provider
- **Transactions are generally made more simple** (documentation, contracts, payment)
- **Flexible** products (tariffs) and supplier switching
- **Strengthening of prosumers** thanks to independence from central authority (direct purchases/sales of energy

RISKS:

- **Complete loss of data** on loss of ID
- Currently **high transaction costs for public blockchain systems**
- Possibly **lack of acceptance** on the part of consumers
- **No authority in the case of disputes**, no direct possibility of escalating conflicts
- **Risk of fraudulent activities** at the interface between the real world and the digital blockchain world (e.g. the smart meter/ blockchain interface)
- **Lack of long-term experience**
- **Technical problems** with initial applications possible to start with
- Insufficient or inadequate functionality and security risks due to **lack of standardization**
- **Networks must cope with greater flexibility**

Source: PwC

Consumer Perspective



Source: PwC

Summary

- Blockchain technology applications in the energy industry are still in their infancy stages. On top of some regulatory and technical constraints, blockchain applications still have to solve its long term security and scalability issues.
- Existing regulation in large electricity markets could hinder the ability of current blockchain-based projects to move from pilots with regulatory exemptions to full commercial deployments. Regulatory intervention is needed.
- The potential for blockchain technology applications in energy is great. Reduced transaction costs and increased transparency will help ensure that existing generation capacity is optimally utilized while energy is made available at its best price.

Thank you!