UCL Energy Institute

UCL CENTRE FOR BLOCKCHAIN TECHNOLOGIES

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# P2P energy trading using ~~blockchain~~ distributed ledgers

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# Distributed ledgers in the energy transition

- **Decarbonisation causes distribution and intermittency leading to:**
  - A 'supply-led' energy system with bi-directional flows at the grid edge requiring local demand-supply matching of large numbers of small energy flows.
- **Digitialisation enables:**
  - Control of distributed, intermittent supply and demand assets at the grid edge
  - Integration of information from energy data across multiple vectors and with non-energy data
  - Markets for value aggregation for energy and non-energy systems
- **Markets require:**
  - Regulation creating value aligned with social goods
  - Transaction cost minimisation minimising trade friction
- **Distributed ledgers enable:**
  - Economic value by transaction costs minimisation through automation and disintermediation
  - Social value by alignment with collaborative economy models and 'localism' agenda.
  - Democratisation by (potentially) vesting power in local actors and cooperatives
  - Differentiation and valuation of monetary and non-monetary social values

# Distributed ledgers: Characteristics

## Trust

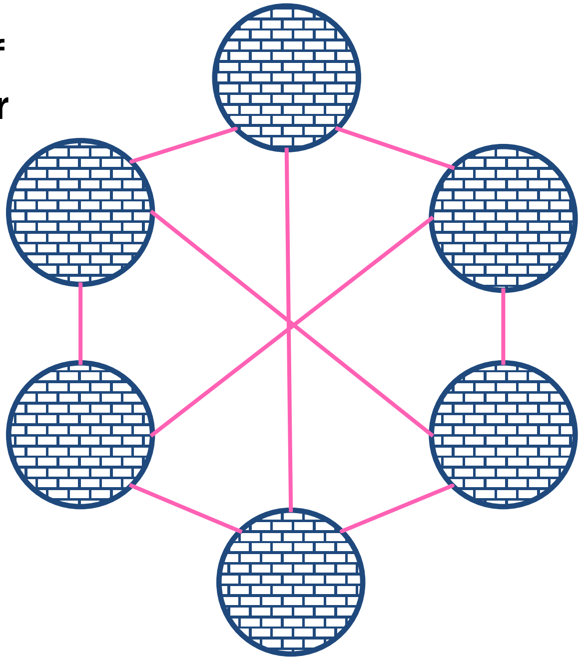
Shift from trust in actors to trust in system. Allows:

- Trading between unknown parties
- Trading between parties of unequal knowledge/power
- Transparency

## Immutability

Allows:

- Guarantees of origin
- Evidence and authentication



## Resilience

Because:

- Distributed control
- Avoids central point of failure

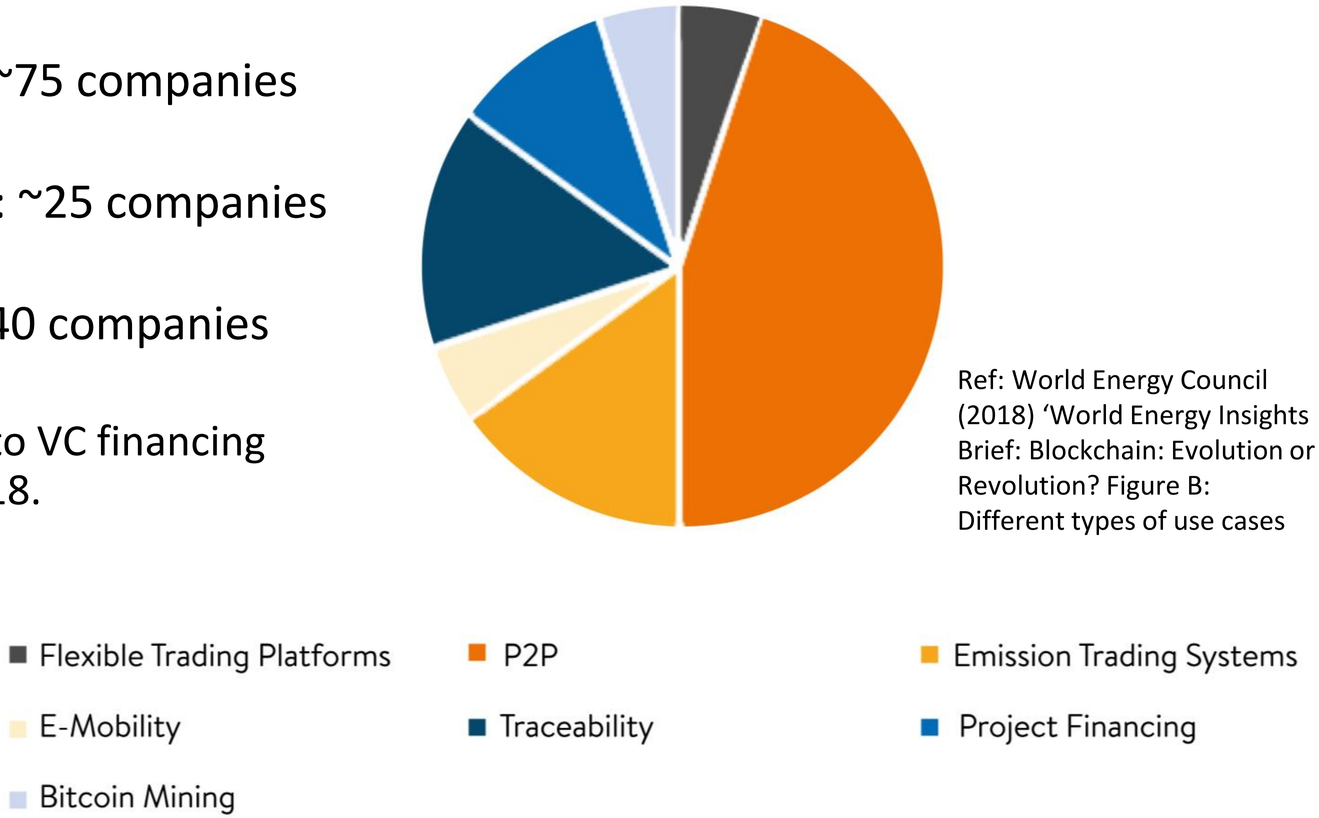
## Digital scarcity

Allows:

- Trading in a zero-sum pooled resource systems like money and energy
- Creating value for non-monetized social goods

# Global shift in investment type and location of energy DLTs

- Start 2017
  - America leading: ~20 companies worth ~$100M
  - Europe second: ~15 companies worth ~$20M
    - ICO financing peaked in Q4 2017
- Mid 2018
  - Europe leading: ~75 companies worth ~$750M
  - East Asia second: ~25 companies work ~$250M
  - America third: ~40 companies worth ~$150M
    - Shift from ICO to VC financing throughout 2018.

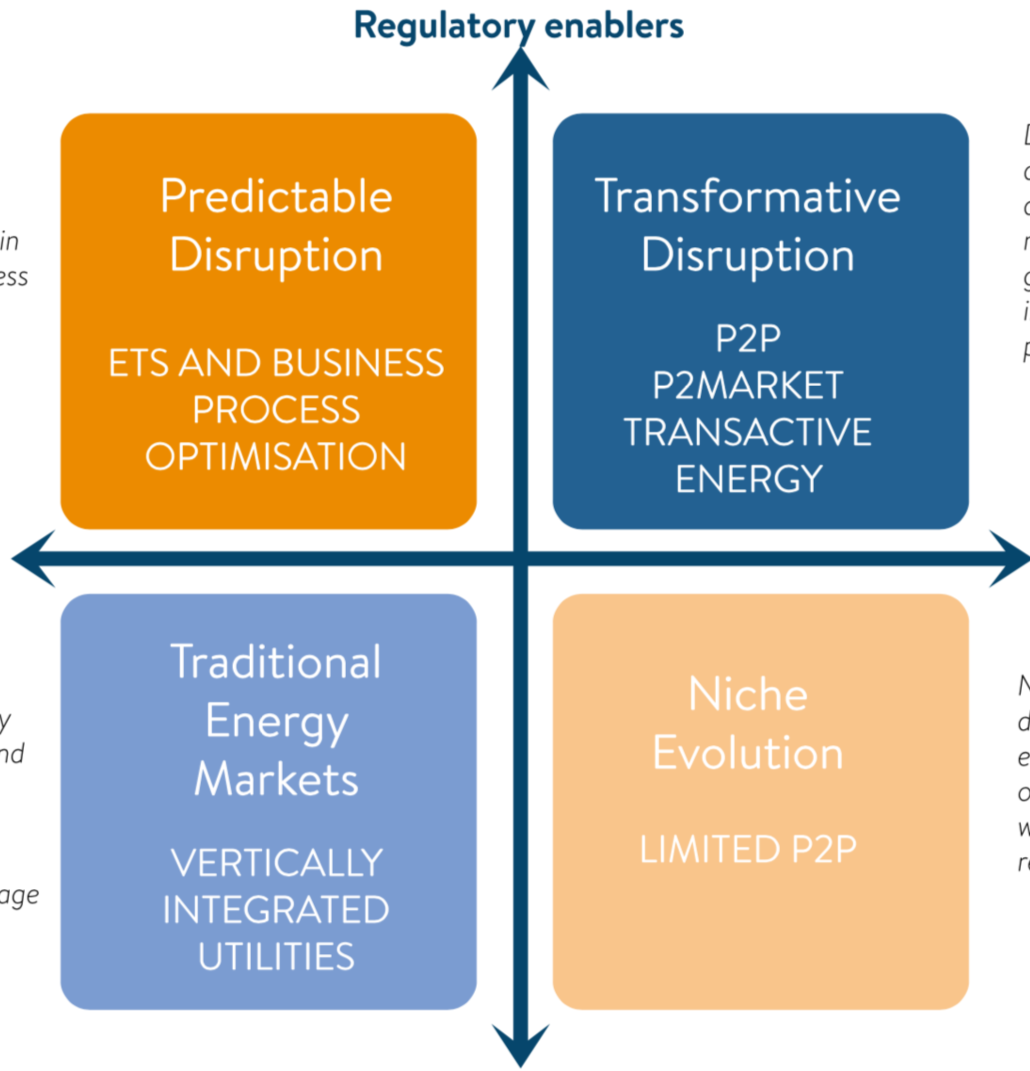



Ref: World Energy Council (2018) 'World Energy Insights Brief: Blockchain: Evolution or Revolution? Figure B: Different types of use cases

# Blockchain in the Energy Sector - Future Outlook

*Limited degree of customer participation in the energy transition due to lack of attractive products. Blockchain uses mainly for business process optimisation and emission trading system registries.*

*Decarbonisation, decentralisation and democratisation of the energy market with a fully transactive grid enabled by a fully digitised infrastructure. Broad DER's and prosumers' participation*




**Lack of customer engagement & Techno-pessimism**

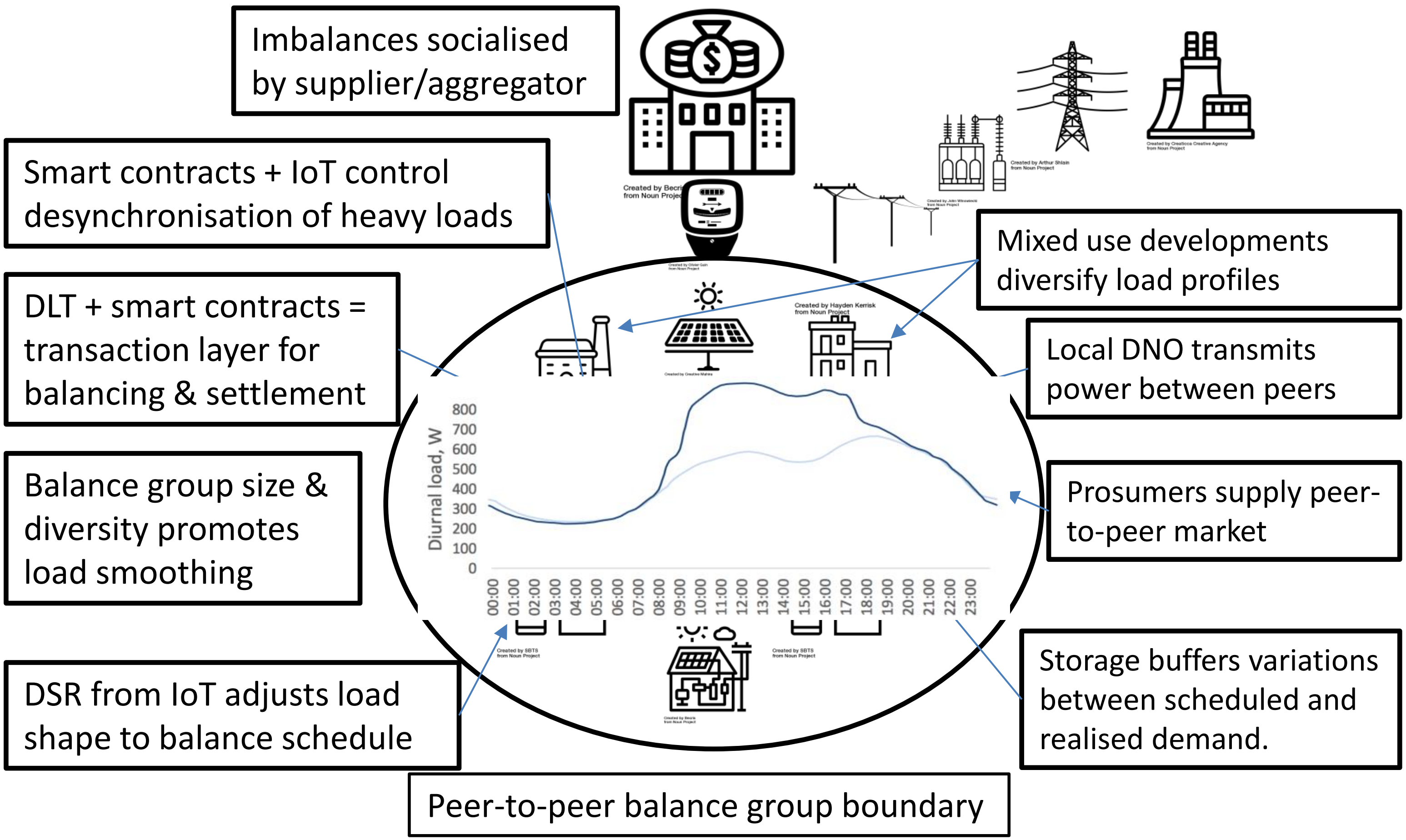
**Customer/prosumer centricity & Techno-optimism**

*Lack of trust in the technology and customer engagement, and regulatory constraints pose hurdles to Blockchain penetration into the energy market. Centralised data storage and business models prevail.*

*Niche sectors use Blockchain to dominate key segments of the energy value chain. P2P trading on a regional and small scale within specific geographies and regulatory framework.*

Ref: World Energy Council (2018) 'World Energy Insights Brief: Blockchain: Evolution or Revolution? Figure D: Blockchain Enabled Scenarios

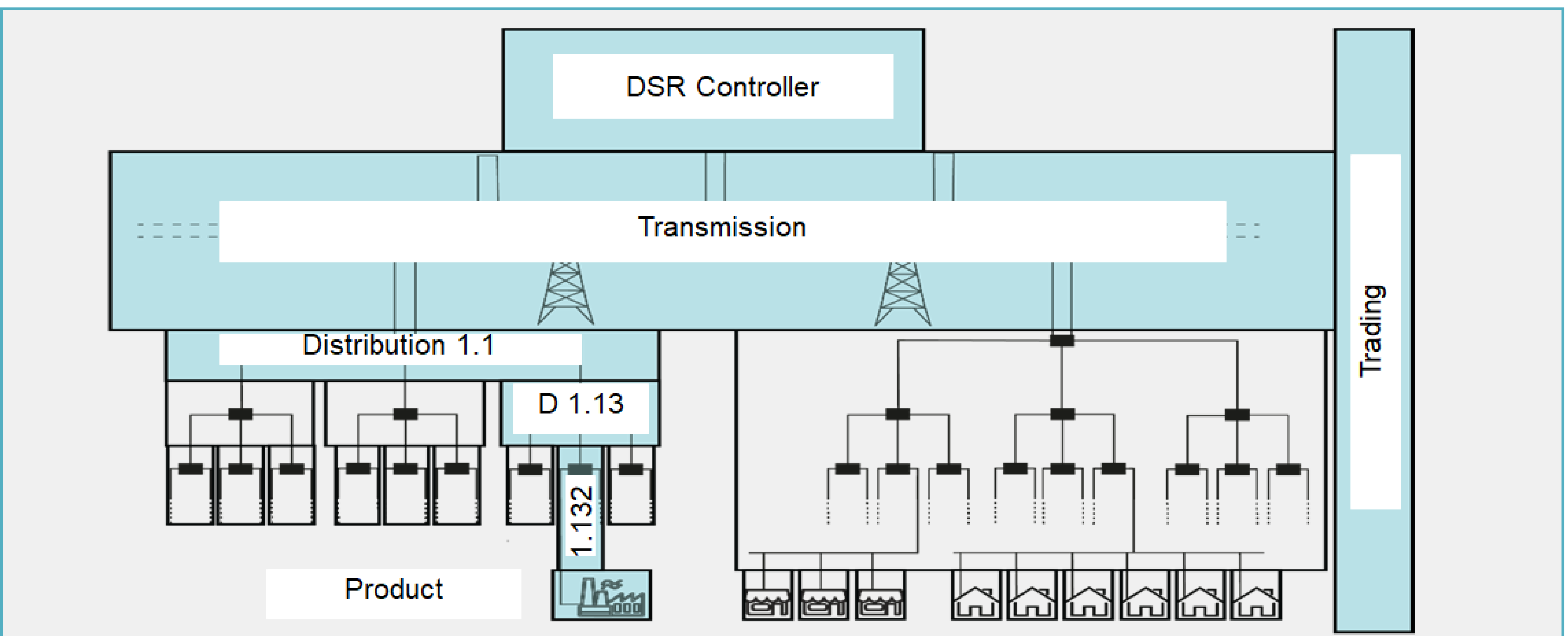
# Peer-to-peer in a picture



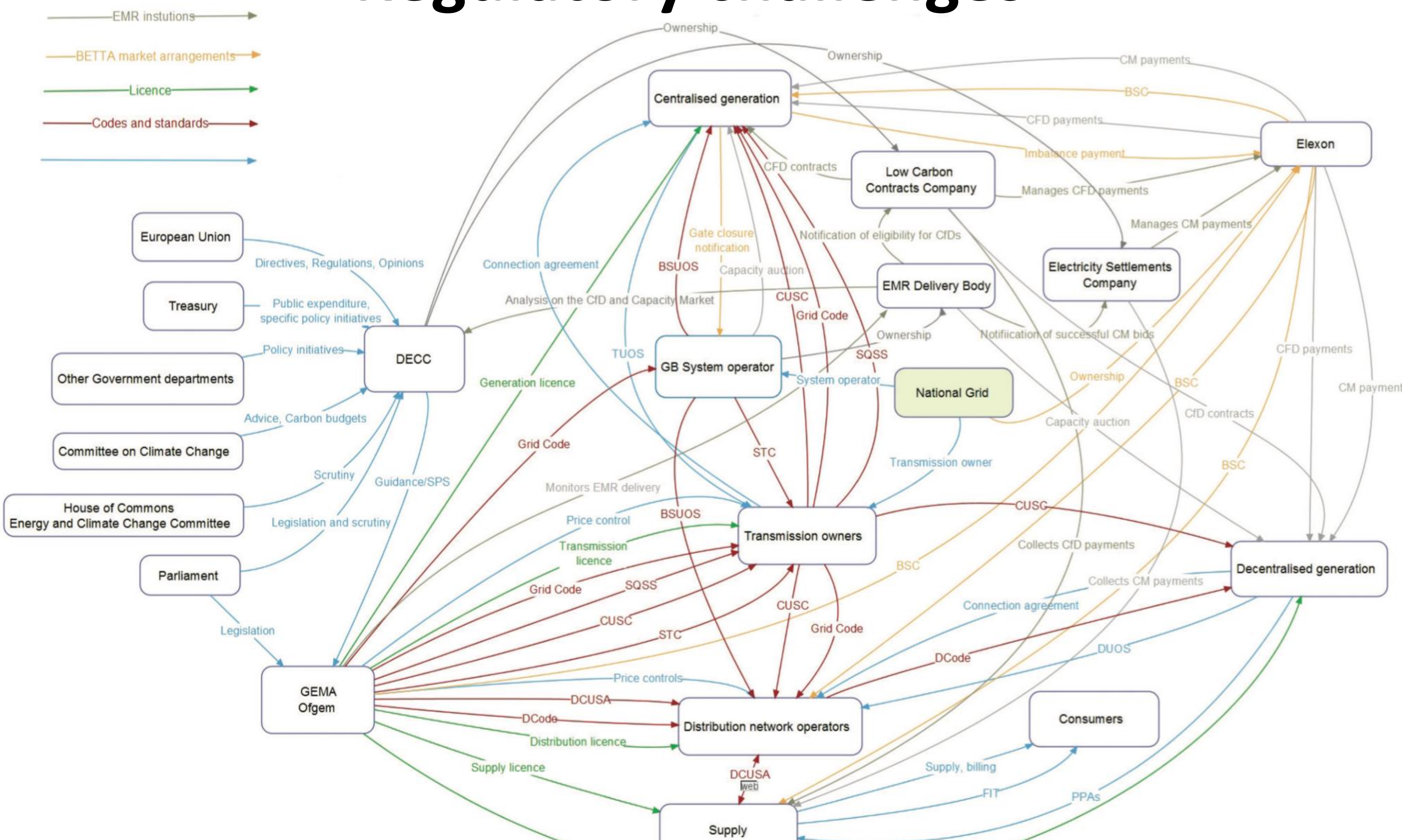
# Electron <electron.org.uk>

- Currently, bilateral trading in the DSR market precludes value aggregation across multiple beneficiaries.
- Electron are looking to release value through collaborative trading of DSR as a non-rival good.
- They disaggregate the components of DSR into its non-rival elements, and allow companies to price them individually.
- They then use blockchain to record all the trading commitments from the industry and enforce the trading protocols of the platform.

- This then:
  - creates fair and transparent DSR value allocation;
  - facilitates trades that wouldn't otherwise happen;
  - Encourages greater liquidity and participation in DSR;
  - generates significant cost savings;
  - leads to better investment decisions; and
  - lowers carbon emissions across the energy industry.



# Regulatory challenges




Ref: Sandys et al (2017) 'ReShaping Regulation' <http://www.challenging-ideas.com/wp-content/uploads/2017/10/Challenging-Ideas_single.pdf> , Figure 1: The institutions and legal, technical and regulatory rules that govern the electricity industry (after Bridget Woodman - Exeter Energy Policy Group)

# Draft EU Renewable Energy Directive (2016/0382(COD))

- Establishment of Rights:
  - Right to self-consumption and sell energy 'including through…peer-to-peer trading arrangements', without additional charges (Article 21)
  - This extends to energy communities (Article 22)
  - Proportionate costs charged to renewable self-consumers for grid management (Article 21)
  - Consumers can jointly engage in self-consumption and form one entity (Article 21)
- Current Status:
  - Agreement reached on 14 June. Awaiting formal approval by European Parliament and Council.

# Council of European Energy Regulators Regulatory Principles for P2P and CSC

**Key Principles:**

- Incorporate self-generation into network planning.
- Consumers as prosumers may entail additional responsibilities.
- Tariffs should be cost-reflective.
- Avoid perverse incentives. Consumers who rely exclusively on the network should not be unduly disadvantaged compared to prosumers.
- No cross-subsidisation.
- Access flexibility mechanisms on a level playing field.
- Adequate metering for prosumers.
- Avoid net metering of self-generation as it implies that system storage capacity is available for free.
  - Ref: CEER Position Paper on Renewable Self-Generation (C16-SDE-55-03)

# CommUNITY project

ofgem Supported through round 1 regulatory sandbox

ELEXON

**Project selected as a part of the Ofgem Sandbox initiative**

EDF ENERGY

Project Lead
**EDF Energy R&D UK**

UCL ENERGY INSTITUTE

Social and behaviour aspects
**University College London**

REPOWERING LONDON

Social enterprise (non-profit) providing the pilot sites
**Repowering London**

ELECTRON

P2P Software platform
**Electron**

EDF ENERGY

P2P trading algorithms
**EDF Energy R&D UK**
Metering, billing and commercial arrangement
**EDF Energy**

passivSYSTEMS

System integration
**PassivSystems**

# CommUNITY – Regulatory Issues

Some regulatory issues related to the CommUNITY trial include:

- **Informed choice principle**: How to compute the estimated annual cost? How to compute the relevant alternative cheapest tariff?
- **Tariffs**: single tariff supply contract including CommUNITY rebate or separate contracts?

Other issues related to different delivery options may include:

| Metering | Billing | Supplier license | Tariffs | Settlement |
|---|---|---|---|---|
| • Recording<br>• Meter ownership<br>• Registering and maintenance of metering asset<br>• Meter resolution | • Multiple-supplier billing<br>• Accounting for self-consumption | • Balancing Settlement Code (BSC)<br>• Distribution code<br>• Grid code<br>• Smart energy code<br>• Master registration agreement (MRA) | • Time of use tariffs<br>• Network charges<br>• Policy charges | • Local settlement for individual consumers |

# Legal Challenges

- **Data privacy and GDPR**
  - Encryption & hashing are pseudonymisation – not anonymisation techniques.
  - Right to be forgotten (Art.17), or for data to be corrected (Art.16) clash with blockchain's immutability.
  - Obligations on controllers and processors of data - who are these in a blockchain?
- **Smart contracts**
  - A smart contract can be considered a 'contract' under UK law
  - Smart contracts are immutable and irreversible, therefore cannot reflect changing circumstances (required in contract law).
- **Prosumer rights**
  - Domestic energy consumers producing their own energy ('prosumers') are not recognised in UK consumer law.
- **Legal protection for P2P participants needed**
  - Co-ops and LLPs can address some, but not all of these issues.

Schneiders, A. & Shipworth, D. (2018) 'Energy Cooperatives: A Missing Piece of the Peer-to-Peer Energy Regulation Puzzle?', BIEE Oxford 2018 Research Conference

# Key messages

- The policy outcome dictates the regulatory change which determines the business model which drives behaviour.
  - Locational charging = local balancing. Flat charging + REGOs = DER uptake
- P2P outcomes depend on how we socialize the cost of network infrastructure.
  - User pays <-> nationalised public asset paid from general taxation
- Permitting multiple suppliers per consumer
  - Peer-to-peer + Peer-to-local market + Peer-to-platform + Backstop supplier
- Commission phase I (PoC); II (uptake) & III (cost-benefit) trials
- Legal challenges exist beyond energy (e.g. GDPR & consumer law)
- Tailor trials to target audience (Govt; social role models; etc)
- UX is key. Must be co-designed & customer led (keep engineers out!)

*"…**without addressing the two obstacles of customer engagement and regulatory reform, a full transformative disruption may not be feasible**; however, energy blockchain will continue to optimise the practices of today's energy eco-system."*

World Energy Council (2018) 'World Energy Insights Brief: Blockchain: Evolution or Revolution?