Blockchain and Smart Contracts in the Energy Industry: A European Perspective

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I. Introduction
I. Introduction

Blockchain & Energy Digitalization

- Blockchain part of broader energy digitalization challenge
- Modern technology meets existing energy law landscape not originally designed to address specific challenges and opportunities of digital world
- Digital, internet driven industries historically did not heat homes or produce the power to run the computers
- Tech & Comms legal framework not geared towards very long term investments in industrial assets, with different security of supply concepts
I. Introduction

Blockchain & Energy Digitalization

- Emerging digitalization is relevant not only in the renewables industry, but also in oil & gas sector:
  - Smart oil fields
  - Smart gas meters
  - Big data & analytics
  - Robotics & drones
  - Internet of Things
  - Blockchain
I. Introduction

Blockchain & Energy Digitalization

- Energy digitalization means combining two previously separate, strongly regulated worlds with different rules
- Challenge: Ensuring that legal system work in such a way that secure, inexpensive, efficient and consumer and environmentally friendly energy will be available also in tomorrow’s digital world
II. Blockchain and Smart Contracts in a Nutshell
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Blockchain & Nutshell

- Blockchain is a distributed, decentralized ledger
  - Enables peer-to-peer transfers of value
  - No need for an intermediary
  - For details, see Satoshi Nakamoto

- Seen as the main technical innovation of Bitcoin and other cryptocurrencies
  - But not limited to cryptocurrencies
II. Blockchain and Smart Contracts in a Nutshell
II. Blockchain and Smart Contracts in a Nutshell

Nodes

- Blockchain software installed and running by user on a machine is called a node.
- Each node stores a copy of the database (list of transactions).
- Nodes used to set up accounts (used by users to participate in the blockchain: create and send new transactions).
- Private keys (a secret number generated for an account) are used to operate accounts.
- Public keys (a public number generated for an account) identify each account on the blockchain.
II. Blockchain and Smart Contracts in a Nutshell

New Transaction

- X and Y users want to send a new transaction to the blockchain (X user transfers Z digital currency to Y).
- X and Y broadcast cryptographically secured digital signatures (combination of their public and private keys) and the details of their transaction to nearby nodes in the network.
II. Blockchain and Smart Contracts in a Nutshell

Validation

• Transactions are sent by accounts and validated in accordance with the consensus protocol (process embedded in the blockchain software used by nodes to reach agreement on whether a transaction can be validated).

• There are different consensus protocols used by different blockchain networks. “Proof of work” is used for the Bitcoin blockchain. Proof of work involves mining.
II. Blockchain and Smart Contracts in a Nutshell

Blockchain Record

- Once a transaction is validated it is recorded on the blockchain.
- Assuming nodes follow the proof of work consensus protocol:
  - Nearby nodes invest compute power to solve a mathematical puzzle required to produce the next block within which the proposed transaction is recorded (this is mining)
  - When the first node solves the mathematical puzzle they win a fee and the pending transaction is recorded in a new block of data
  - That new block is double checked by other members of the network until a majority agrees it is correct and then it's added to the blockchain and becomes part of the database
II. Blockchain and Smart Contracts in a Nutshell

Types of Blockchain

<table>
<thead>
<tr>
<th>Public Blockchain</th>
<th>Private Blockchain</th>
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<tbody>
<tr>
<td>• Open: anyone can participate</td>
<td>• Consortium Blockchains: pre-selected, trusted nodes control the consensus process</td>
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<tr>
<td>• Decentralized</td>
<td>• Fully private Blockchains: write permissions in the hand of centralized organization</td>
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<tr>
<td>• Special consensus mechanisms, e.g. proof of work / proof of stake</td>
<td>• Less resource-intensive, faster</td>
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<tr>
<td>• Needs substantial amount of (computational) power, slower</td>
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II. Blockchain and Smart Contracts in a Nutshell

Smart Contracts

- Promises in digital form, performed by the parties within protocols
- E.g. vending machine – or far more complex
- Ethereum combines Blockchain and Smart Contracts
  - Platform with Turing-complete programming language
  - Suitable for any transaction that can be defined mathematically

source: https://www.ethereum.org/
II. Applications in the Energy Industry
III. Applications in the Energy Industry

Blockchain & Physics

- Blockchain moves/stores data, not power.
- Energy is physical, requires generation/production, storage, transformation, transportation and delivery.
- "Energy supply is not a computer game, but the real world."
- Someone needs to make sure that the energy physically gets to where it is supposed to go, really, reliably, lawfully, always.
III. Applications in the Energy Industry

Blockchain & Physics

- On the other hand:
  - Renewables have lead to vast increase in number of decentralised, intermittent producers, with ever increasing need to balance supply and demand, ever increasing data requirements to match supply and demand
  - Data ever increasingly relevant to supply power, really, reliably, lawfully, always
- Need to understand interdependence to understand and resolve legal issues
III. Applications in the Energy Industry

**Brooklyn Microgrid**

- Owners of PV systems sell their power in the neighbourhood using Ethereum Blockchain
- Communal energy network, with utility provider still maintaining and balancing the electrical grid, the actual energy is generated, stored, and traded locally by members of the community
- Similar projects in Europe: [OneUp](https://www.brooklyn.energy/) (Netherlands), [Conjoule](https://www.brooklyn.energy/) (Germany)

Source: https://www.brooklyn.energy/
III. Applications in the Energy Industry

Enerchain

- True P2P wholesale electricity and gas trading based on Blockchain with major European companies participating
- Potential to bypass trading platforms and brokers on the wholesale electricity market

Source: https://enerchain.ponton.de/
III. Applications in the Energy Industry

Applications in Oil & Gas Trading

- **Vakt**: Blockchain platform facilitates trade in crude oil and other commodities by digitizing and centralizing post-trade processes.

- **BTL Interbit platform**: speeds up reconciliation processes in gas trading.

source: https://www.vakt.com/

source: http://btl.co/
IV. Legal Issues of Blockchain-based Solutions in the European Union
IV. Legal Issues of Blockchain-based Solutions in the European Union


- Main goals: open, liberalized internal energy market, security of supply, energy efficiency & saving, promotion of renewable energy and interconnection of networks
- EU shares legislative competence with member states
- Range of regulations and directives regulate electricity and natural gas markets
- Latest legislative proposal: "Clean Energy for All Europeans" (Winter Package, EU Commission)
IV. Legal Issues of Blockchain-based Solutions in the European Union


- No specific laws on Blockchain/Smart Contracts
- October 2017: European Council asked Commission to look into Blockchain
- February 2018 Commission launches EU Blockchain Observatory and Forum
- 10 April 2018 Blockchain Partnership Declaration
  - Signed by 25 EU Member States
  - Shall support the delivery of cross-border digital public services, with the highest standards of security and privacy
IV. Legal Issues of Blockchain-based Solutions in the European Union

1. Energy Law: Current regulatory issues

- Prosumers likely to be considered "suppliers" \(\rightarrow\) numerous obligations
  - Terms and conditions, billing, information on energy mix to be made available to consumers
  - Obligation to contribute to grid balancing / managing their own balancing group?
  - In some countries: suppliers' licenses and universal service obligations
- Supplier changes within max. three weeks vs. supplier changes within minutes in Blockchain-based electricity trading
IV. Legal Issues of Blockchain-based Solutions in the European Union

1. Energy Law: Current regulatory issues

- High regulatory burden for P2P electricity trading: EU energy law was not drafted with Blockchain & Smart Contracts in mind
- Blockchain-based P2P electricity transactions between prosumers only feasible if external service provider fulfils obligations on behalf of prosumers
  - Blockchain as a tool to avoid the need of an intermediary?
IV. Legal Issues of Blockchain-based Solutions in the European Union


- "Active customers": entitled to generate, store, consume and sell self-generated electricity in all organized markets without being subject to disproportionately burdensome procedures (Electricity Directive Recast)

- "Peer to peer trading": sale of renewable energy between market participants by means of a contract with pre-determined conditions governing the automated execution and settlement of the transaction ... directly between market participants (Renewable Energy Directive adopted in Dec 2018)
IV. Legal Issues of Blockchain-based Solutions in the European Union


● "Renewables self consumers": right to sell their excess electricity through P2P trading arrangements without being subject to discriminatory or disproportionate procedures, charges and unjustified regulatory barriers (Renewable Energy Directive)

♫ Winter Package tries to ease the burden for P2P electricity trading

♫ But: actual impact will depend on transposition in national law. Namely: Which procedures are disproportionate? Which regulatory barriers are unjustified?
IV. Legal Issues of Blockchain-based Solutions in the European Union

2. Contract Law

- The attractive part: automatic performance and enforcement of legal obligations
  - "no room to bring an action for breach when breach is impossible" (Werbach & Cornell 2017)
- The difficult part: Things go wrong. Drafting a contract (and code) that takes into account all possible contingencies and states all their responses is not possible
- Coders will have to cooperate with lawyers to ensure legally sound design of the contract & reasonably bulletproof contract code
IV. Legal Issues of Blockchain-based Solutions in the European Union

3. Consumer Protection Law

- Extremely developed in the EU: unfair contract terms, information requirements, cooling-off periods, withdrawal rights in "distance contracts"
- Are prosumers traders or consumers?
  - Probably both, depending on their role
- Does all consumer protection law apply to smart consumer contracts?
  - Cooling-off periods in smart contracts don't make sense
  - Exception for "automatic vending machines" may apply to smart contracts: automated exchange of goods
IV. Legal Issues of Blockchain-based Solutions in the European Union

4. Data Protection Law

- EU General Data Protection Regulation (GDPR), in force since 2018
- Broad territorial scope: controllers/processers who process personal data of EU data subjects, related to offering goods/services in the EU
- "Personal data": any information relating to an identified or identifiable natural person
- Even pseudonymized information, e.g. IP addresses
- Blockchain: transactional data linked to a person & pseudonymized public key can be personal data
IV. Legal Issues of Blockchain-based Solutions in the European Union

4. Data Protection Law

- Rights of data subjects (examples):
  - Access personal data and information relating to data processing (Art. 15)
    - Enforcement in the Blockchain: Who is the data controller? Difficult without a platform operator (public Blockchain): Each node?
  - Right to rectification of inaccurate personal data (Art. 16) and right to erasure of personal data (Art. 17)
    - Blockchain is an immutable, append-only ledger...
IV. Legal Issues of Blockchain-based solutions in the European Union

4. Data Protection Law

- Solutions for GDPR compliance within a Blockchain
  - Interpretation: Does supplementary statement qualify as rectification of data?
  - Technical modifications:
    - storing personal transactional data off-chain, so it can be modified retroactively
    - Private Blockchains governed by rules on data processing and third parties validating transactions (rather than mining)
    - Zero-Knowledge-Proof: transactions that don't make any of the parties identifiable
IV. Legal Issues of Blockchain-based solutions in the European Union

4. Data Protection Law

- To what extent Blockchain is compatible with GDPR remains uncertain
- Draft Proposal for a new ePrivacy Regulation and proposal for recast of the Electricity Directive do not address the issue
IV. Legal Issues of Blockchain-based solutions in the European Union

5. Financial Markets Regulation

- Directive on Markets in Financial Instruments (MiFID II)
  - Authorization requirements for provision of investment services (i.e. trading of options, futures, swaps, forwards, other derivative contracts relating to commodities)
  - May be relevant for Blockchains enabling wholesale electricity trading
  - Do virtual currencies qualify as "financial instruments" under MiFID II?
    - Either way, the use of a virtual currency as a means of payment alone does not trigger obligations under MiFID II
IV. Legal Issues of Blockchain-based Solutions in the European Union

5. Financial Markets Regulation

- Regulation on Wholesale Energy Market Integrity (REMIT)
  - Prohibits insider trading and market obligations; extensive reporting obligations
  - Who is responsible for ensuring compliance in Blockchain based P2P trading systems?
  - Enerchain requires each participant to report trades in accordance with REMIT
V. Conclusions
V. Conclusions

• Very different forms of Blockchain & smart contract based applications in the energy industry

• Compatibility with EU (energy) law depends largely on their specific design: private Blockchains are easier to reconcile with legal framework, but lack features of Blockchain prototype

• EU "Winter Package" addresses issues related to Blockchain and smart contracts, but does not set up a comprehensive legal framework

• But: Blockchain and smart contracts play an increasing role in the energy industry – industry players, computer people and lawyers will need to make them work
V. Q & A
Thank you

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