

## Results

**Political, legal and technological factor groups – the most important for the introduction and use of blockchain in renewable energy**

**Promising use cases – certificates of origin and smart grid applications**

### Background

The urgency to reach net-zero emissions until 2050 has created a vast interest in **innovative technologies for renewable energy** sector. At the same time **digitalization processes** in the economy should play a key role. Usually, renewable energy is produced by **decentralized systems** that are challenging to overview with a single centralized management technique.

One of the promising technologies for **both digital finance and renewable energy development could be blockchain**. It constitutes immutable and decentralized ledgers, capable of securely archiving digital transactions without the necessity for a centralized governing entity. While operating on a decentralized system (**distributed ledger technology**), blockchain with the use of cryptography ensures **trustfulness, security and transparency** of recorded immutable transactions that cannot be changed by single member of the ledger.

The goal of this study is to **develop a methodology for the selection of the most appropriate blockchain applications** in renewable energy and to **identify and evaluate the possible types of use** considering socio-economic, political and legal, technological and environmental factors.

### Methodology

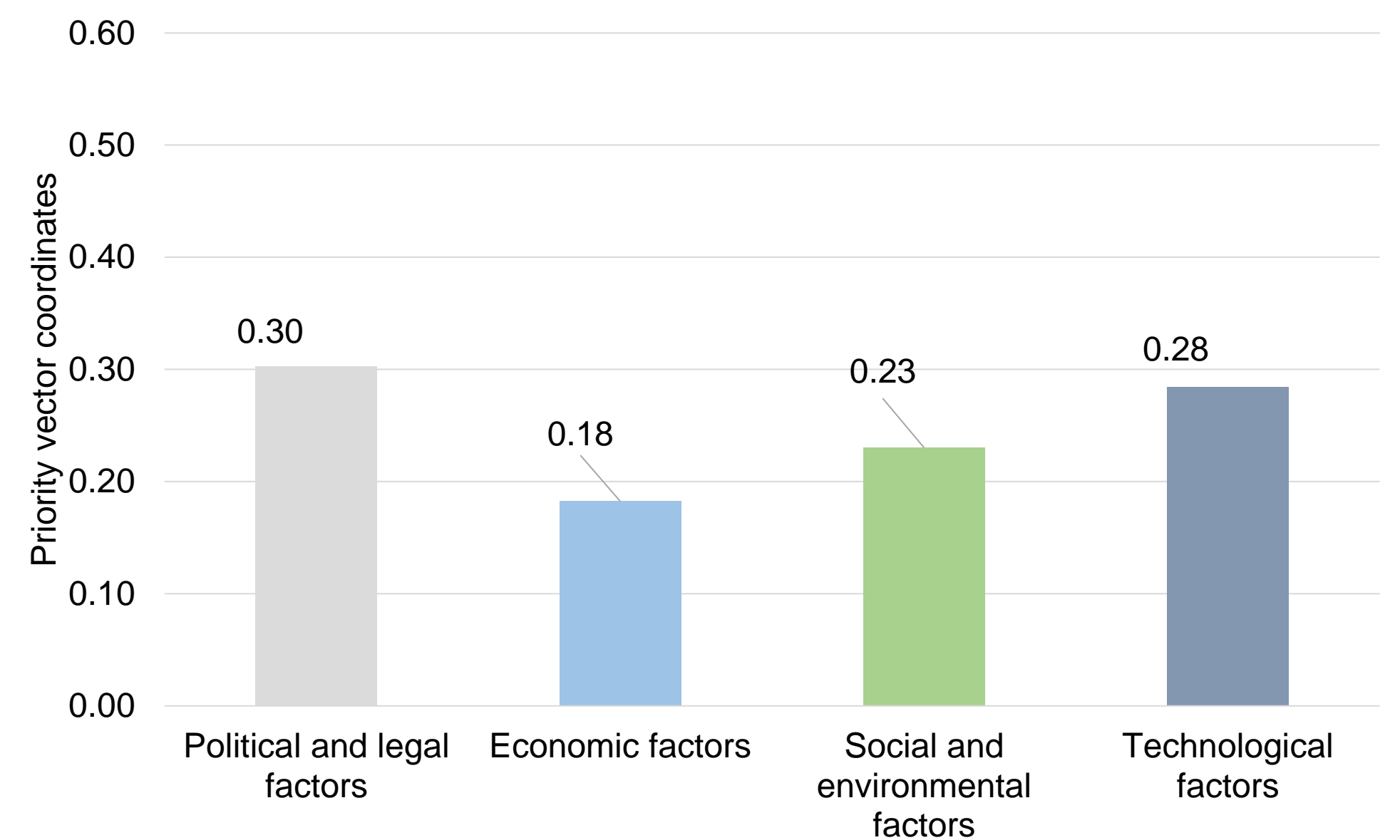
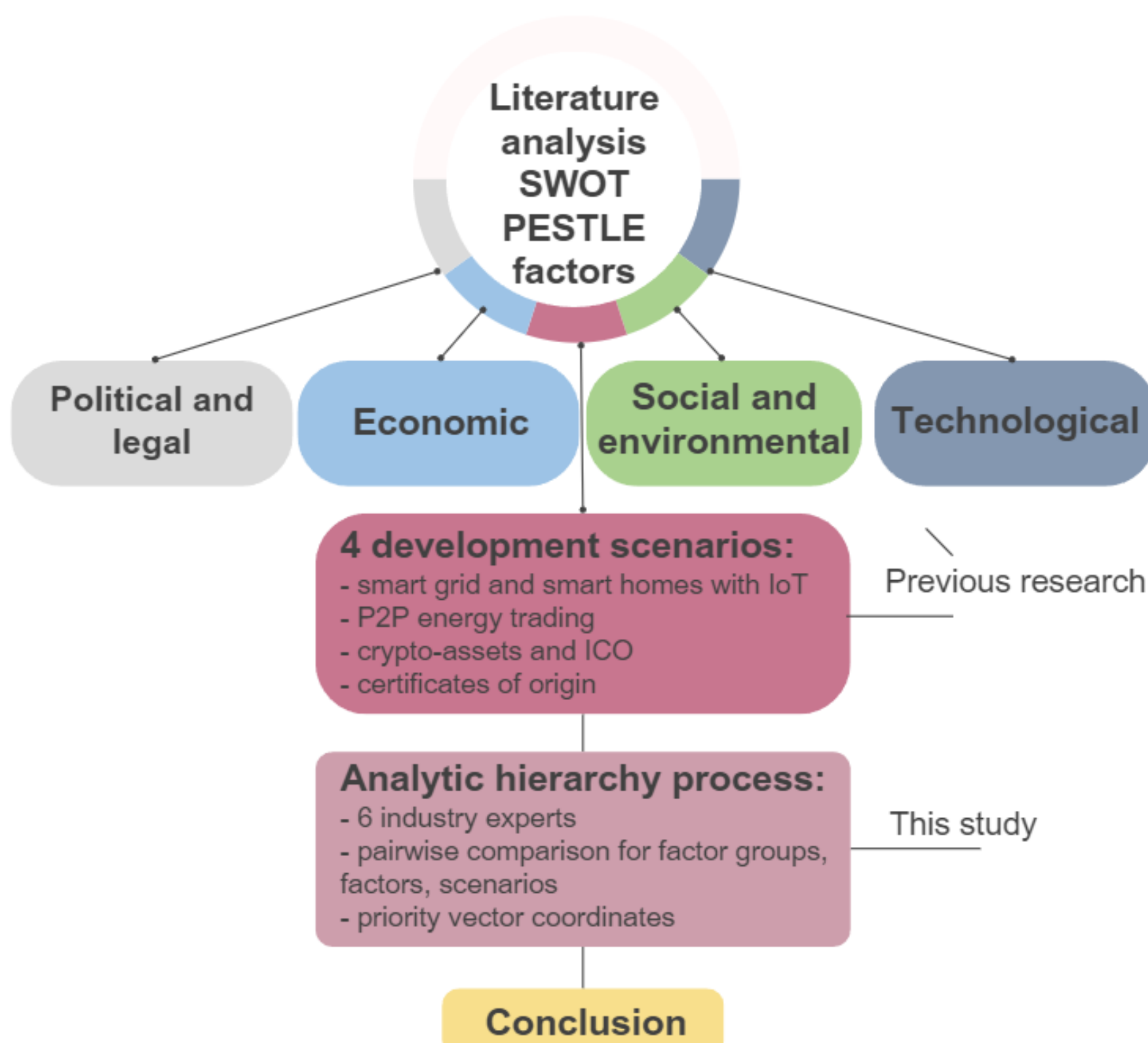


Fig. 1. Comparison of factor groups influencing blockchain use in renewable energy (n = 6)

The most significant factor groups influencing the use of blockchain technology in the renewable energy sector are **political, legal and technological** (Fig. 1), pointing to the difference in the principles of operation of blockchain from the traditionally used solutions, as well as the need to **strengthen the regulatory and policy planning framework** for the successful development of technology in the renewable energy.

The most promising use cases for blockchain would be associated with **reliable and immutable certificates of origin** for renewable energy and use in **smart grid** (including smart metering), **smart homes and relevant Internet of Things applications** (Fig. 2). The use of **crypto-assets** and **initial coin offerings** for renewable energy development should be viewed with precaution and willingness to **inform and educate** considering social factors like public opinion and societies' knowledge on crypto-assets.

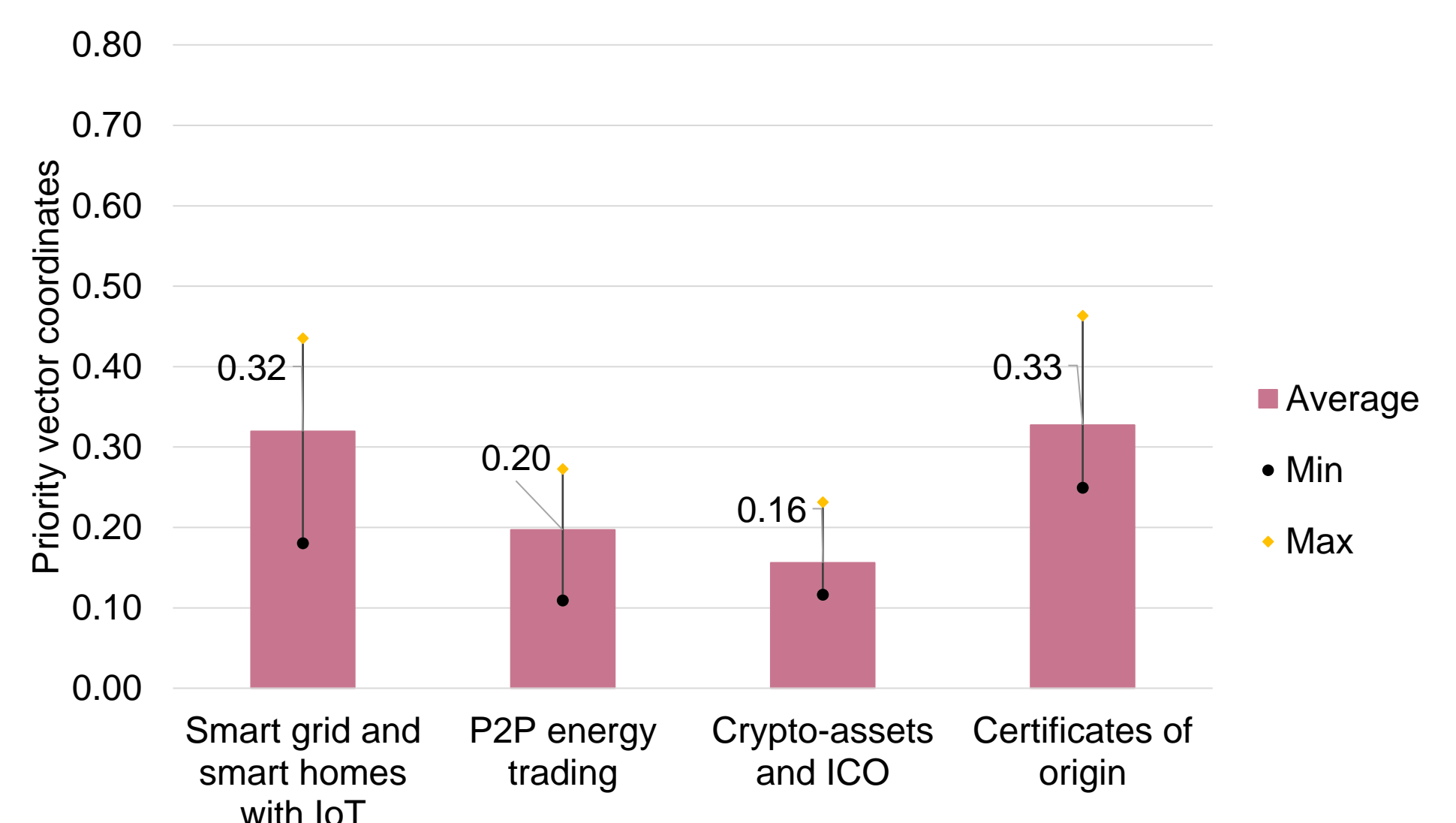


Fig. 2. Overall assessment of blockchain application scenarios in renewable energy (n = 6)

### Conclusion

It is advisable to **define the involvement of authorities** in the management of the use of blockchain technology, taking into account at the same time the **decentralized nature** of the technology and the **absence of third-party involvement**, as well as the need to protect consumer rights.

It is recommended to develop a **common, standardized blockchain-based solution for issuing certificates of origin** for renewable energy at the **European Union level** to ensure a common, immutable and unchangeable system for issuing certificates in real time in all European Union Member States.