Scientists explore the potential for a truly decentralised energy system

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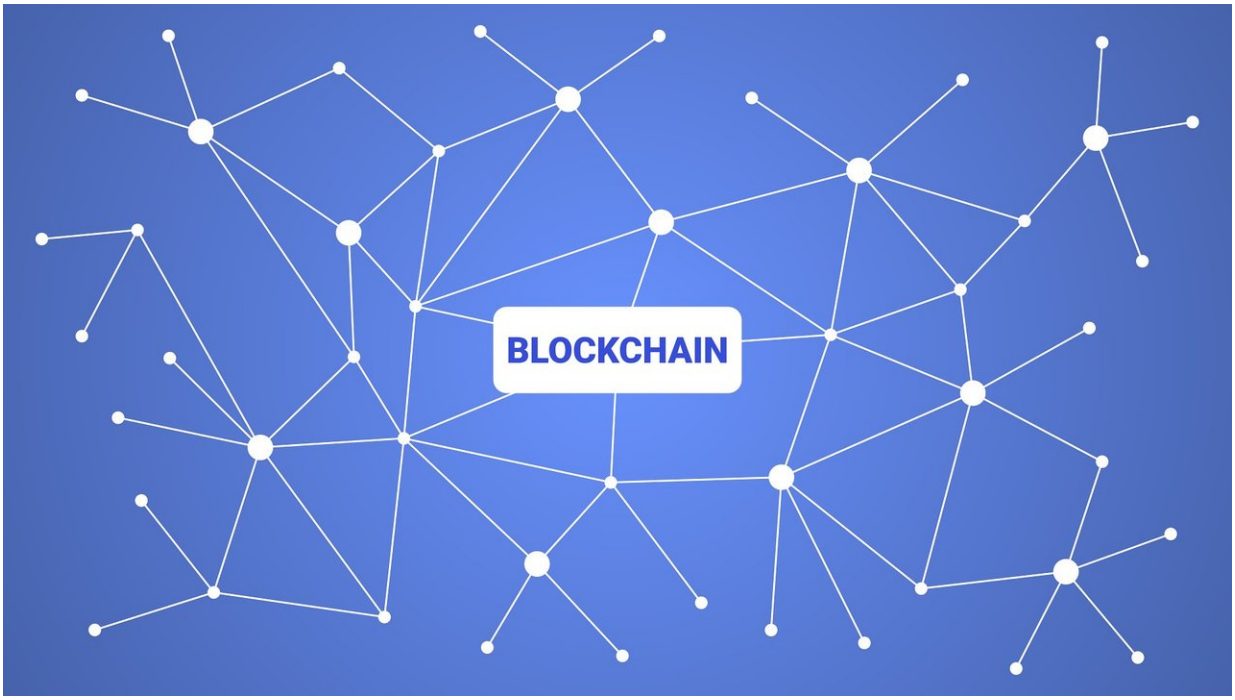

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Writing in the journal *Renewable and Sustainable Energy Reviews*, Heriot-Watt University scientists have published one of the first unbiased, major comprehensive reviews of blockchain technology.

Interest in blockchain technologies in the energy sector has skyrocketed in the past few years, with rapid developments and significant private

and public investments in projects at all stages of the maturity cycle, from technology development and user trials to actual deployments.

In its simplest form, blockchain is a ledger that can securely store digital transactions without the need for a central point of authority and can be shared across a network of computers. Once a block is added to the chain, it is difficult to change, making the ledger secure without a central authority.

The paper discusses how different competing technologies are delivering on their promise, as well as reviewing results from over 140 projects, start-ups and initiatives in this area, covering all areas of blockchains in energy, from transactive community energy models, to balancing and trading emission certificates.

Blockchains have been used for some time to underpin cryptocurrencies like Bitcoin and Ethereum, but the interest in blockchains in energy systems is a more recent development, which has taken some parties in the energy sector by surprise.

A growing number of industrial and academic projects have focused on the role that blockchain technology can play in building tomorrow's more resilient and decentralised energy systems.

Dr. Valentin Robu, associate professor at Heriot-Watt University, explains: "Blockchains are often described as holding the promise of enabling a more decentralised, transactive energy system. If we can enable energy generation and use them at a local level, this could allow system operators to reduce expensive network reinforcements, as well as make local communities more energy self-sufficient and resilient to outside shocks in power supply.

"In energy applications, blockchains are often deployed in combination

with artificial intelligence (AI) techniques such as multi-agent systems and machine learning, which enable smart micro-contracts and local energy exchanges. This can potentially enable building systems and energy service providers to identify consumer energy patterns and develop energy products tailored to the needs of individual consumers.

"Our paper discusses both the technology issues surrounding blockchains, but also reviews more than 140 start-ups or running projects, investigating how this rapidly evolving technology is actually delivering on its promises in a number of areas directly related to energy."

Merlinda Andoni, a research associate from Heriot-Watt University, continues: "Energy systems are on the brink of entering the digitalisation era as more and more homes install smart meters and smart devices, and system operators increasingly adopt information and communication technologies (ICT). Blockchain could potentially be used for automated and secure communication of such smart devices that would further facilitate smart grid applications and decarbonisation of the energy sector."

The researchers caution that blockchain technologies need to address several issues before achieving larger adoption including legal and regulatory challenges, security and scalability of computation, as well privacy concerns. Other emerging issues in transactive energy models refer to the need of accounting the costs for managing the physical infrastructure and guaranteeing system stability, and the role that system operators will play in a more decentralised energy world.

More information: Merlinda Andoni et al. Blockchain technology in the energy sector: A systematic review of challenges and opportunities, *Renewable and Sustainable Energy Reviews* (2018). DOI: 10.1016/j.rser.2018.10.014