

Leveraging surplus electricity: Profitability of bitcoin mining as a national strategy in South Korea

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This study is the first in the world to empirically investigate the integration of surplus electricity—specifically, electricity remaining after net metering—into Bitcoin mining operations. Unlike prior research that focuses on mining profitability or renewable energy usage, this work pioneers an energy-financial framework by proposing Bitcoin mining as a strategic application for repurposing excess grid power. By using the latest Antminer S21 XP Hyd device and modeling Bitcoin price with both Random Forest Regressor and Long Short-Term Memory (LSTM) networks, the study quantifies profitability under operational scenarios of 30,565 and 45,439 units. The findings demonstrate that surplus electricity, traditionally underutilized or wasted, can be transformed into a source of economic value—reducing energy loss, alleviating unresolved payments, and directly contributing to the debt reduction and financial stability of Korea Electric Power Corporation (KEPCO).

By establishing a data-driven, operational model that links energy surplus with cryptocurrency mining, this study not only proves the technical and financial feasibility of such a system but also sets a precedent for future global energy policy and Bitcoin infrastructure. It introduces a new method where surplus energy becomes a valuable asset in digital finance—an innovation that may reshape how nations view grid management, decentralized technologies, and energy economics.