

Renewable energy won't make Bitcoin 'green,' but tweaking its mining mechanism might

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The cryptocurrency Bitcoin is known for its massive energy footprint. Now, researcher Alex de Vries, from PricewaterhouseCoopers (PwC) in the Netherlands, suggests that renewable hydropower production cannot supply the large quantities of energy needed to power machinery used to validate Bitcoin transactions. In a Commentary publishing March 14 in the journal *Joule*, he also highlights the vast quantities of electronic waste produced by the Bitcoin network and calls for alternative strategies to curb the cryptocurrency's environmental impact.

de Vries, a senior consultant and blockchain specialist at PwC and founder of Digiconomist (@DigiEconomist), found that Bitcoin's consumption is more than 1,200 times greater than the maximum footprint of a transaction processed by the banking industry. He also estimates that Bitcoin consumed as much electrical [energy](#) as all of Hungary in 2018.

"Proponents of this digital currency have argued that, even if Bitcoin is using a lot of energy, it's not

that harmful because they claim Bitcoin mining facilities use mostly excess renewable energy," says de Vries. "I decided to deep dive into this claim."

The problem lies primarily in the Bitcoin mining mechanism, in which "miners" use high-powered technology to search for valid numerical signatures that allow Bitcoin blocks (files recording Bitcoin transactions) to join the growing list of Bitcoin transaction records known as the "blockchain." In return for their efforts, miners may (but don't always) receive Bitcoin currency.

Using publicly available information about the computational power of the Bitcoin network and the efficiency and material composition of mining machines, de Vries identified major problems with reliance on renewable energy. Once a Bitcoin machine is activated, it is not shut down until it fails to continue operating profitably. Nevertheless, while this elevated electricity demand remains constant, the hydropower used to fuel it fluctuates. The Sichuan province of China, where miners are primarily located according to Bitcoin proponents, is generating three times more hydroelectricity during the wet summer months than during the dry winter months. Climate change is only expected to exacerbate this volatility, and coal-based energy is typically used to balance out these fluctuations.

"Based on these findings, the renewable energy currently going into Bitcoin mining cannot be considered 'green,' and this challenge of combining a constant energy requirement with variable renewable production will always exist," says de Vries. "It might even provide an incentive for the construction of new coal-based power plants in order to meet the higher base demand."

But de Vries also notes that even if Bitcoin mining

devices could run on renewable energy alone, they would still be discarded as [electronic waste](#) at the end of their lifespans. The most popular machine on the market, an Application-Specific Integrated Circuit (ASIC) miner, cannot be repurposed because it is hardwired solely for mining Bitcoin. This means it is likely to wind up with other cast-off electronics in a landfill or incinerator, causing damage to the environment. Altogether, the study shows that Bitcoin currently generates as much electronic waste as a small nation, such as Luxembourg.

Even though Bitcoin still only constitutes a small portion of all currency transactions, de Vries thinks there is already cause to be concerned. "Its energy consumption and electronic waste generation are certainly not negligible at the moment, and they will likely escalate quickly to even more extreme amounts if Bitcoin manages to become widely used," he says.

However, de Vries believes these sustainability concerns can be averted by replacing the mechanism used to mine Bitcoin. An alternative "proof-of-stake" mechanism already used by the cryptocurrencies Dash and NXT (and soon to be used by Ethereum, which is transitioning away from a mining mechanism similar to Bitcoin's) does not depend on computing power to build the blockchain. This adjustment would cut Bitcoin's energy consumption by a striking 99.99% and would eliminate the need for specialized, non-repurposable hardware.

"Ultimately, Bitcoin is just software," says de Vries. "The [mining](#) mechanism can be replaced. The challenge is that the entire network needs to agree to this change."

More information: *Joule*, de Vries: "Renewable Energy Will Not Solve Bitcoin's Sustainability Problem" [https://www.cell.com/joule/fulltext/S2542-4351\(19\)30087-X](https://www.cell.com/joule/fulltext/S2542-4351(19)30087-X) , [DOI: 10.1016/j.joule.2019.02.007](#)

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