

From the Washington Post

Energy and Environment

Bitcoin's popularity has a downside: It's an energy glutton that could hurt Earth's climate, study finds

The new research finds that bitcoin's greenhouse gas emissions are already comparable to those of a midsize country. But critics aren't so sure.



Technicians inspect a bitcoin-mining operation at Bitfarms in Saint-Hyacinthe, Quebec, on March 19. (Lars Hagberg/AFP)

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October 29

Bitcoin, the cryptocurrency that has taken world markets by storm, may already be driving greenhouse gas emissions equivalent to those of a midsize country, and a study released Monday said it could catapult the planet to dangerous levels of warming if it continues its rapid growth.

At least one critic cautioned that the new research “makes much too coarse and even wrong assumptions” — demonstrating that even as the cryptocurrency, worth about [\\$6,400](#) per coin, grows in visibility, estimating precisely how it is affecting the environment remains hotly debated.

There’s no doubt bitcoin is [notorious for its high energy use](#) — the consequence of miners having to compute highly difficult problems to make a “[blockchain](#)” of transactions and win new bitcoin. This, in turn, requires high-powered, energy-hungry equipment.

These miners are well known for flocking to places with cheap electricity so that they can get a better return on mining. Sometimes, that means setting up near hydroelectric dams, in which case mining would not produce any greenhouse gas emissions. But in other cases, miners tap into electricity grids powered largely by coal plants.

Because bitcoin is a currency not maintained by banks but by a network of individuals, it relies on a technology called blockchain that is decentralized and depends on a vast number of users, called miners, to compute a record of transactions. The computer users who do the laborious calculations are paid in bitcoin, which encourages yet more computing. No single entity manages the entire system, which eats tremendous amounts of energy from computers constantly solving problems to build the blockchain.

The problem is that as the price of bitcoin rises, there is more incentive to mine — after all, there’s a better chance of making a good return. But the way bitcoin is set up, when this happens, the problems that must be solved also become [more computationally difficult](#), requiring still more machinery and, thus, more energy use.

The study, published in *Nature Climate Change*, seeks both to compute the current energy use of bitcoin mining and what it could be in the future if the technology continues to grow. And it finds not only country-size present-day emissions but also potentially planet-size affects from further growth.

“That to me was the mind-blowing thing about this,” said Camilo Mora, a researcher at the University of Hawaii who published the work with his students.

Mora computed present-day greenhouse gas emissions tied to bitcoin by analyzing the energy efficiency of the hardware that mining uses and the countries in which the mining groups are based — mostly China, but also the United States and several other nations.

The result of the calculation was that bitcoin, today, probably releases about 69 million tons of carbon dioxide emissions — comparable with the emissions of [a country like Austria](#), which has a population of nearly 9 million people.

It's a big deal for anything to be emitting at a country scale — and given how much trouble nations are having cutting emissions right now, anything new at this scale is nothing to sniff at. Still, with global carbon dioxide emissions at about 41 billion tons, bitcoin would represent just a fraction of the total.

But the study then compared a hypothetical future rate of bitcoin adoption to the history of technologies such as the credit card, the dishwasher and electricity itself, and it found that if bitcoin continues to catch on — and if computations to record transactions and generate new bitcoin become ever more complex and demanding — greenhouse gas emissions from the mining could explode.

“If this thing grows to anything that resembles how technologies are included in society, this could easily exceed 2 degrees of warming within two decades,” Mora said.

But the new work is contentious and probably not the final word on the subject.

“Extrapolation using the other commonly used technologies will be speculative, but not unreasonable,” David Malone, a lecturer at Maynooth University in Ireland, said in an email. Malone previously calculated that bitcoin's energy demand was equal to that of Ireland itself.

Challenges faced by bitcoin could limit its use, Malone noted, rendering the analysis less accurate.

“They talk a little bit about the problems that bitcoin has to overcome (for example, squeezing more transactions into a block and these might improve efficiency),” he wrote. “However, it is also possible that these limitations might limit Bitcoin's growth, and so limit the growth in CO₂ emissions.”

Another problem with the study is that it uses a countrywide average to determine the greenhouse gas emissions for a given amount of electricity use. But depending on where you're located in a country — using the United States as an example — your actual greenhouse gas emissions from using electricity can vary a lot because of the different power sources used to generate it.

For instance, some bitcoin miners have [set up in eastern Washington state](#) because of the cheap access to hydroelectric power in that location. This has been highly disruptive to local communities, but hydropower is a renewable energy resource, so the greenhouse gas footprint of such mining would be very low or even possibly zero.

Harald Vranken, a professor at the Open University in the Netherlands who has studied bitcoin's energy demands, raised this concern, and a number of others, in a strong critique of the study.

One of the biggest problems with the research, he said in an email, is the assumption that a growing number of transactions will power bitcoin's energy use. "It definitely is wrong to project that bitcoin's energy consumption will increase linearly with the number of transactions!"

Another, he said, is that not all miners who are part of a given group are necessarily even located in the same country. And large mining groups may operate in multiple countries.

"I think it is questionable whether the estimated amount of CO₂ produced by bitcoin mining in 2017 is right, and it is even more questionable whether projections for the future are right given the falsified assumption that more transactions implies more mining effort," Vranken concluded.

Still, there's no doubt that bitcoin uses a lot of energy.

Is there a solution? Mora says that, simply put, bitcoin has to change the way it operates. For instance, changing the difficulty of the problems that must be computed, or including more transactions in each calculation.

The world could also switch entirely to renewable energy, and then bitcoin mining would be as green as anything else — but we're hardly there yet.

"This is a good time for the people who have the power to operate these things to be aware of this potential threat that bitcoin is having," Mora said. "And they have choices that are viable to reduce those emissions considerably right now."
