Congressional Research Service
Informing the legislative debate since 1914

IN FOCUS

December 15, 2022

Recent Cryptocurrency Developments: Energy and Environmental Implications

Cryptocurrency mining ("cryptomining") is the process of creating additional units of cryptocurrency—a type of digital asset—and validating cryptocurrency transactions on a blockchain ledger. According to some estimates, cryptomining consumes around 1% of annual global electricity usage and exceeds the total electricity usage of some nations. This has raised concerns and prompted initiatives to address the environmental impact of resulting greenhouse gas (GHG) emissions. Congress has expressed interest in the environmental impact of cryptomining, as well as recent developments within the cryptocurrency industry and potential regulatory approaches to addressing related policy issues. For more information, see CRS Report R45863, *Bitcoin, Blockchain, and the Energy Sector*, by Corrie E. Clark and Heather L. Greenley.

Cryptocurrency Industry Developments

As cryptocurrencies have gained popularity, industry has taken some actions to address their increasing energy consumption, reliance on fossil fuels, and resulting GHG emissions.

Many popular cryptocurrencies use an energy-intensive transaction validation process called *Proof of Work* (PoW), which requires substantial amounts of energy to operate and thermally regulate the devices computing the required calculations. On September 15, 2022, in a highly publicized event called the "Merge," the Ethereum blockchain shifted from PoW to a less energy-intensive *Proof of Stake* (PoS) validation process. While there are other blockchain networks that use PoS, the Merge is significant because the Ether cryptocurrency is the second largest cryptocurrency by market capitalization and the largest cryptocurrency to transition from PoW to PoS. Ethereum predicted the Merge would cut its energy consumption by 99.5%, which has been supported by some outside estimates. According to news outlets, the Merge prompted some Ethereum miners to either cease operation or switch mining to other PoW blockchain networks since their equipment could no longer be used on PoS networks. These changes reduced the overall energy consumption of the Ethereum blockchain, but may have increased the consumption of other networks as miners migrated.

Other private-sector efforts have focused on switching to renewable energy sources to reduce reliance on fossil fuels. The Crypto Climate Accord is an alliance of industry members who have committed to net-zero emissions by 2030 for all their crypto-related operations. Critics contend that cryptomining's energy consumption, a "feature" of the PoW system, could continue to grow and draw renewable electricity generation away from other sectors and negate their potential beneficial impact on GHG emissions.

The energy intensity of cryptomining rises and falls with profitability. In 2022, the prices of various cryptocurrencies dropped substantially, which impacted mining profitability and, subsequently, total energy consumption. The exact impact is difficult to measure due to the lack of public data from cryptomining companies. However, the Cambridge Bitcoin Electricity Consumption Index has noted that expected mining profitability and expected price trajectory are two driving factors of Bitcoin's energy consumption. When the cost of electricity and maintenance exceeds the profit from cryptomining, miners potentially may power down existing equipment, stop buying and using new mining equipment, or sell off cryptocurrency reserves, which may in turn affect prices and profitability. However, low prices do not guarantee permanent decreased energy consumption. Historically, the value of cryptocurrencies has been volatile, so low prices could rise in the future, which could lead to an increase in energy consumption.

Policy Developments

Among other actions by Congress, in 2022, the House Committee on Energy and Commerce held a hearing on the energy impact of cryptocurrencies. Further, several Members of Congress have written letters to federal agencies, such as the U.S. Environmental Protection Agency (EPA), to ensure mining facilities are not violating the Clean Air Act or Clean Water Act.

In March 2022, President Biden signed Executive Order (E.O.) 14067 on the responsible development of digital assets. In response to E.O. 14067, the White House Office of Science and Technology Policy (OSTP) released a report, "Climate and Energy Implications of Crypto-Assets in the United States." The report examines how digital assets affect energy consumption, the scale of consumption relative to other energy uses, the opportunities of blockchain technologies to support climate monitoring or mitigation, and potential policy options to minimize or mitigate the climate, energy, and environmental effects of cryptomining. The report is part of the first whole-of-government approach to address cryptocurrency risks and benefits, according to the Administration. It also provides recommendations for agencies and Congress, such as legislation to limit or eliminate energy-intensive transaction validation processes.

The international regulatory landscape also has changed in recent years. In 2021, the Chinese government banned all cryptocurrency transactions, which caused an exodus of cryptocurrency miners to other countries, including the United States. Reportedly, a portion of Chinese miners have continued their operations illegally, but the ban impacted the overall global distribution of cryptomining and,

consequently, total energy consumption and fuel mix. Some research indicates that fossil fuel use for cryptomining has increased since the ban, possibly because of lost access to Chinese hydropower and miner migration to countries with a higher reliance on coal and natural gas sources for power. As cryptomining has increased in the United States, the U.S. share of cryptomining energy consumption has increased. According to the OSTP report, cryptomining currently accounts for 2% of total annual U.S. electricity consumption, which is comparable to the annual consumption of all other data centers in the United States.

Energy and Climate Implications

Observers estimate cryptomining's electricity consumption grew rapidly from 2017 to 2022. However, it is unclear how developments in recent months have impacted total energy consumption of various cryptocurrency networks. Some estimates have shown recent signs of decreased cryptomining power demand and energy consumption, while others have not. The full impact of recent changes may be delayed. There are many different factors that influence total cryptomining energy consumption and subsequent GHG emissions, some of which may have additive or counteractive effects. For example, if companies shift their energy consumption to electricity produced from renewable energy sources, the global GHG emissions associated with cryptomining could decrease. However, an increase in the price or expected value of certain cryptocurrencies may attract more miners and thereby increase overall cryptocurrency energy consumption.

Considerations for Congress

Agency Authorities

Congress may consider the role of agencies over certain aspects of cryptomining, including energy usage, noise pollution, water consumption, grid reliability, heat production, and electronic waste of mining equipment. Some questions include the extent to which agencies have appropriate authority, the manner in which agencies are exercising any authority, and whether agencies might benefit from any additional authority or direction that Congress might wish to provide. Examples of agencies and potential areas of focus could include the following:

- **Department of Energy (DOE).** Energy efficiency standards (voluntary or mandatory) for cryptomining operations (or data centers) or mining equipment.
- **Energy Information Administration (EIA).** Data collection to analyze cryptomining energy consumption, including mining energy usage, fuel mix, and power agreements.
- **Environmental Protection Agency (EPA).** Data collection or environmental performance standards (voluntary or mandatory) for cryptomining facilities.
- **Federal Energy Regulatory Commission (FERC).** Analysis of potential risks or benefits of blockchain technologies to grid operations and the consideration of the growth of domestic cryptomining operations in existing grid reliability standards.

Some Members of the 117th Congress introduced several bills to address cryptocurrency energy consumption and agency authorities, including the following examples. S. 4356 would direct FERC in consultation with the Commodity Futures Trading Commission (CFTC) and Securities and Exchange Commission (SEC) to analyze the energy consumption of digital asset transactions and the effects of energy consumption. Other proposals would require the CFTC to examine energy consumption (H.R. 8730, H.R. 8950, and S. 4760).

Oversight of Blockchain Networks

Congress may consider whether to maintain, expand, limit, or eliminate the use of certain energy-consumptive blockchain validation processes, or whether to encourage cryptocurrency networks to switch to less energy-intensive processes. Measures to regulate validation processes may have unintended consequences in other spheres, such as financial oversight. For example, on the day of the Merge, SEC Chairman Gary Gensler noted that Ethereum's new, less energy-intensive transaction validation process, which requires miners to maintain a financial stake in Ethereum, could qualify the cryptocurrency as a *security*, a particular investment of money that is regulated by the SEC.

State Frameworks

Congress may consider options to facilitate state and local efforts to manage regional effects of growth in cryptomining, or whether a comprehensive federal framework is needed. Some state legislatures, such as New York, have enacted legislation to limit the energy and environmental impacts of cryptomining. The New York legislation (Ch. 628) established a two-year moratorium on all PoW cryptomining that uses carbon-based fuel, such as oil, coal, or natural gas. Other states have attracted cryptomining facilities to their states through general data center-based state and local tax benefits. Still other states—such as Kentucky—have enacted legislation (Acts Ch. 122 and 141) to provide sales and use tax incentives and create renewable energy incentive programs specific to cryptomining.

Industry-Led Efforts

Congress may assess existing industry initiatives to address energy and environmental impacts of cryptomining. Congress may weigh the possible effects of any further policy action on private-sector innovation and cryptocurrency development. Some cryptomining operations are relatively mobile, so additional regulation may lead some mining companies to move their operations abroad. Additionally, the SEC's proposed climate-related disclosure rules for public companies (17 C.F.R. §§210, 229, 232, 239, and 249) would require all public companies, including public cryptomining companies, to report their direct GHG emissions, among other things. If adopted, these reporting requirements could render obsolete some industry-led transparency efforts by publicly traded cryptomining companies.

Kristen E. Busch, Analyst in Science and Technology Policy
Corrie E. Clark, Specialist in Energy Policy

IF12286

Disclaimer