SEPTEMBER 08, 2022

FACT SHEET: Climate and Energy Implications of Crypto-Assets in the United States

Climate change is one of the most pressing problems confronting our nation and our world, and President Biden has taken bold steps to address it with legislation and policy. Among the President's commitments are: protecting communities from pollution, reducing greenhouse gas emissions by 50% by 2030, achieving a carbon pollution-free electricity grid by 2035, and reaching net-zero greenhouse gas emissions no later than 2050.

To achieve these ambitious goals, we must ensure that emerging technologies contribute to a net-zero, clean energy future. The use of digital assets based on distributed ledger technology (DLT) is expanding. Digital assets are a form of value, represented digitally. As an emerging technological innovation, digital assets have provided some benefits and value for some residents and businesses in the United States, and have the potential for future benefits with emerging uses.

Crypto-assets are digital assets that are implemented using cryptographic techniques. Crypto-assets can require considerable amounts of electricity usage, which can result in greenhouse gas emissions, as well as additional pollution, noise, and other local impacts to communities living near mining facilities. Depending on the energy intensity of the technology and the sources of electricity used, the rapid growth of crypto-assets could potentially hinder broader efforts to achieve U.S. climate commitments to reach net-zero carbon pollution.

In March, in **Executive Order 14067 on Ensuring the Responsible Development of Digital Assets**, President Biden made clear that the responsible development of digital assets includes reducing negative climate impacts and environmental pollution. The Executive Order directed the

White House Office of Science and Technology Policy (OSTP), in coordination with other federal agencies, to produce a report on the climate and energy implications of crypto-assets in the United States. OSTP assembled an interdisciplinary team of experts to assess and extend existing studies with new analysis, based on peer-reviewed studies and the best available data.

Today, OSTP published its report, **examining the challenges and opportunities of crypto-assets for the United States' clean energy and climate change goals, and providing a set of recommendations to further study and track impacts of the sector, develop potential performance standards, and provide tools and resources to reduce negative impacts.** This report's assessment and recommendations align with federal actions that reduce greenhouse gas emissions to protect public health and welfare, grow a clean energy economy with good-paying jobs, and improve environmental justice.

Crypto-Assets Can Be Energy-Intensive, and the United States Has a Major Crypto-Asset Sector

From 2018 to 2022, annualized electricity usage from global crypto-assets grew rapidly, with estimates of electricity usage doubling to quadrupling. As of August 2022, published estimates of the total global electricity usage for crypto-assets are between 120 and 240 billion kilowatt-hours per year, a range that exceeds the total annual electricity usage of many individual countries, such as Argentina or Australia. This is equivalent to 0.4% to 0.9% of annual global electricity usage, and is comparable to the annual electricity usage of all conventional data centers in the world.

Nearly all crypto-asset electricity usage is driven by consensus mechanisms: the DLT used to mine and verify crypto-assets. The dominant consensus mechanism is called Proof of Work (PoW), which is used by the Bitcoin and Ethereum blockchains. Bitcoin and Ether combined represent more than 60% of total crypto-asset market capitalization. The PoW mechanism is designed to require more computing power as more entities attempt to validate transactions for coin rewards, and this feature helps disincentivize malicious actors from attacking the network. As of August 2022, Bitcoin is estimated to account for 60% to 77% of total global crypto-asset electricity

usage, and Ethereum is estimated to account for 20% to 39%.

The energy efficiency of mining equipment has been increasing, but electricity usage continues to rise. Other less energy-intensive crypto-asset ledger technologies exist, with different attributes and uses. Switching to alternative crypto-asset technologies such as Proof of Stake could dramatically reduce overall power usage to less than 1% of today's levels.

The United States is estimated to host about a third of global crypto-asset operations, which currently consume about 0.9% to 1.7% of total U.S. electricity usage**. This range of electricity usage is similar to all home computers or residential lighting in the United States**. Crypto-asset mining is also highly mobile. The United States currently hosts the world's largest Bitcoin mining industry, totaling more than 38% of global Bitcoin activity, up from 3.5% in 2020. Despite the potential for rapid growth, future electricity demand from crypto-asset operations is uncertain, demonstrating the need for better data to understand and monitor electricity usage from crypto-assets.

Crypto-Assets Can Have Significant Environmental Impacts

Global electricity generation for the crypto-assets with the largest market capitalizations resulted in a combined 140 ± 30 million metric tons of carbon dioxide per year (Mt CO_2/y), or about 0.3% of global annual greenhouse gas emissions. Crypto-asset activity in the United States is estimated to result in approximately 25 to 50 Mt CO_2/y, which is 0.4% to 0.8% of total U.S. greenhouse gas emissions. **This range of emissions is similar to emissions from diesel fuel used in railroads in the United States**.

Besides purchased grid electricity, crypto-asset mining operations can also cause local noise and water impacts, electronic waste, air and other pollution from any direct usage of fossil-fired electricity, and additional air, water, and waste impacts associated with all grid electricity usage. These local impacts can exacerbate environmental justice issues for neighboring communities, which are often already burdened with other pollutants, heat, traffic, or noise. The growth of energy-intensive crypto-asset technologies, when not directly using clean electricity, could hinder the ability of the United States to achieve its National Determined Contribution under the Paris Agreement,

and to avoid the most severe impacts of climate change. Broader adoption of crypto-assets, and the potential introduction of new types of digital assets require action by the federal government to encourage and ensure responsible development. This includes minimizing negative impacts on local communities, significantly reducing energy intensity, and powering with clean electricity.

Distributed Ledger Technologies May Help with Climate Monitoring or Mitigation

DLT may have a role to play in enhancing market infrastructure for a range of environmental markets like carbon credit markets, though other solutions might work as well or better. The potential benefits of DLT would need to outweigh the additional emissions and other environmental externalities that result from operations to merit broader use, relative to the markets or mechanisms that DLT displaces. Use cases are still emerging, and like all emerging technologies, there are potential positive and negative use cases yet to be imagined. Responsible development of this technology would encourage innovation in DLT applications while reducing energy intensity and minimizing environmental damages.

Key Recommendations of the Report

To help the United States meet its climate objectives, crypto-asset policy during the transition to clean energy should be focused on several objectives: reduce greenhouse gas emissions, avoid operations that will increase the cost of electricity to consumers, avoid operations that reduce the reliability of electric grids, and avoid negative impacts to equity, communities, and the local environment.

To ensure the responsible development of digital assets, recommendations include the following actions for consideration:

- **Minimize greenhouse gas emissions, environmental justice impacts, and other local impacts from crypto-assets:** The Environmental Protection Agency (EPA), the Department of Energy (DOE), and other federal agencies should provide technical assistance and initiate a collaborative process with states, communities, the crypto-asset

industry, and others to develop effective, evidence-based environmental performance standards for the responsible design, development, and use of environmentally responsible crypto-asset technologies. These should include standards for very low energy intensities, low water usage, low noise generation, clean energy usage by operators, and standards that strengthen over time for additional carbon-free generation to match or exceed the additional electricity load of these facilities. Should these measures prove ineffective at reducing impacts, the Administration should explore executive actions, and Congress might consider legislation, to limit or eliminate the use of high energy intensity consensus mechanisms for crypto-asset mining. DOE and EPA should provide technical assistance to state public utility commissions, environmental protection agencies, and the crypto-asset industry to build capacity to minimize emissions, noise, water impacts, and negative economic impacts of crypto-asset mining; and to mitigate environmental injustices to overburdened communities.

- **Ensure energy reliability:** DOE, in coordination with the Federal Energy Regulatory Commission, the North American Electric Reliability Corporation and its regional entities, should conduct reliability assessments of current and projected crypto-asset mining operations on electricity system reliability and adequacy. If these reliability assessments find current or anticipated risks to the power system as a result crypto-asset mining, these entities should consider developing, updating, and enforcing reliability standards and emergency operations procedures to ensure system reliability and adequacy under the growth of crypto-asset mining.

- **Obtain data to understand, monitor, and mitigate impacts:** The Energy Information Administration and other federal agencies should consider collecting and analyzing information from crypto-asset miners and electric utilities in a privacy-preserving manner to enable evidence-based decisions on the energy and climate implications of crypto-assets. Data should include mining energy usage and fuel mix, power purchase agreements, environmental justice implications, and demand response participation. OSTP could establish a National Science and Technology Council subcommittee to coordinate with other relevant agencies to

assess the energy use of major crypto-assets.

- **Advance energy efficiency standards:** The Administration should consider working with Congress to enable DOE and encourage other federal regulators to promulgate and regularly update energy conservation standards for crypto-asset mining equipment, blockchains, and other operations.

- **Encourage transparency and improvements in environmental performance:** Crypto-asset industry associations, including mining firms and equipment manufacturers, should be encouraged to publicly report crypto-asset mining locations, annual electricity usage, greenhouse gas emissions using existing protocols, and electronic waste recycling performance.

- **Further research to improve understanding and innovation:** For improved analytical capabilities that can enhance the accuracy of electricity usage estimates and sustainability, the National Science Foundation, DOE, EPA and other relevant agencies could promote and support research and development priorities that improve the environmental sustainability of digital assets, including crypto-asset impact modeling, assessment of environmental justice impacts, and understanding beneficial uses for grid management and environmental mitigation. Research and development priorities should emphasize innovations in next-generation digital asset technologies that advance U.S. goals in security, privacy, equity, and resilience, as well as U.S. climate goals.

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