STATEMENT OF

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Chairman Pallone, Subcommittee Chairwoman DeGette, Ranking Member McMorris Rogers, Subcommittee Ranking Member Griffith, and members of the committee, thank you for inviting me here today to discuss the energy impact of blockchain technology and related cryptocurrency activities. This topic is an important one for anyone who cares about American competitiveness in the sustainable energy sector, a decentralized technology ecosystem that empowers individual people over powerful central decisionmakers, and the next iteration of the Internet in which individuals are able not only to read information and write content but also own a piece of the underlying network protocols themselves.

My name is Brian Brooks, and I was born and raised in Pueblo, Colorado. I am CEO of Bitfury Group, a company that provides a suite of infrastructure products and services, including but not limited to bitcoin mining, that support various aspects of the cryptocurrency ecosystem – an ecosystem many in the technology world refer to as "Web 3" since crypto assets generally represent either the rewards paid to participants for maintaining a particular decentralized network or an app that operates on such a network. My previous career experiences include time spent as Acting U.S. Comptroller of the Currency, Chief Legal Officer of the cryptocurrency exchange Coinbase, and General Counsel of Fannie Mae.

Bitfury is both a bitcoin miner and a provider of various infrastructure solutions related to blockchain technology. Our majority-owned subsidiary Cipher Mining, Inc. is a publicly traded company listed on NASDAQ and headquartered in New York. Since 2011, Bitfury's total deployed and in-development bitcoin mining data centers total more than 1 GW of total production. We have also designed and produced eight successive generations of ASIC[1] chips and related equipment for conducting transaction validation activity on the bitcoin blockchain – a process known informally as bitcoin mining. Along the way, Bitfury developed a series of adjacent businesses to make crypto assets safe, sustainable, and useful. Our various businesses include Crystal, a blockchain analytics company that provides transaction monitoring and related compliance tools to more than 150 law enforcement agencies, crypto exchanges, and financial services companies in Europe, Asia, and North America; Axelera, a producer of cutting-edge artificial intelligence ASIC chips; and LiquidStack,[2] one of the world's largest immersion cooling companies focusing on reducing by as much as 90 percent the cooling energy used by bitcoin mining and other high-performance data centers.

Bitcoin in particular and cryptocurrencies more generally were created as decentralized alternatives to traditional banking and finance. In addition to

[1] Application-Specific Integrated Circuit (ASIC): a microchip designed for a specific use rather than for general use.
[2] https://liquidstack.com/industries

decentralizing the financial system, cryptocurrency has emerged more recently as the foundation of a more decentralized, user-controlled alternative to the current Internet. Decentralization is achieved either by rewarding unrelated groups of people for devoting computing power to validating transactions and maintaining the network – also known as proof of work – or by validating and maintaining the network based on the share of tokens held by the operators of validator nodes. Bitcoin, a proof of work token, also operates as a store of value due to its algorithmic rationing of supply; a recent Goldman Sachs report estimates that the global store-of-value market is comprised of roughly 20 percent bitcoin and roughly 80 percent gold, with bitcoin gaining market share over time.

I view the Subcommittee's topic today through two lenses.

First, in assessing environmental concerns about bitcoin mining or any other energy use, not all energy consumption is created equal. An activity that consumes 100 TW of power derived exclusively from coal or oil adds carbon to the environment and consumes a scarce resource; an activity that consumes the same amount of power derived from a mix of solar, wind, and hydropower does neither. So it is important that bitcoin not be judged solely on the basis of how ***much*** energy it uses, but rather on the basis of its energy mix relative to other energy users in the economy and on the basis of the incentives bitcoin creates for creating a more sustainable energy mix.

Second, from a public policy perspective, the most relevant question should be energy ***production*** rather than energy ***consumption*** – if the people's representatives decide we should eliminate or reduce a particular source of energy such as coal or oil, you were elected to do that. But once the energy mix has been established, in a market economy like the United States, markets – meaning the aggregate decisions of American consumers and businesses – should decide the most productive use of the energy that is produced. We should think about the energy consumption of any given activity based on the economic productivity created per unit of energy consumed, as well as based on that productivity ratio relative to other alternative uses of that energy – especially uses that would be replaced by the activity in question. Thus, for example, if bitcoin competes as a store of value with gold, then an appropriate question is whether the energy used in bitcoin mining produces more economic value per unit of energy than gold mining. If bitcoin and other cryptocurrencies compete with banks as a means of payment, then an appropriate question is whether the energy used in bitcoin mining produces more economic value per unit of energy than banking.

Bitcoin Mining's Energy Usage and Energy Mix

The available data suggests that bitcoin mining consumes a small but nontrivial amount energy relative to the amount of value created, and that that energy is on average drawn more from sustainable sources than the U.S. electric

grid as a whole. There are several different sources one could examine to reach this conclusion, including the Bitcoin Mining Council comprised of the major global mining companies, the Cambridge Bitcoin Electricity Consumption Index, and others. Using BMC data for convenience, bitcoin mining last year consumed 188 TWh out of about 155,000 TWh consumed globally for all uses. The energy mix used for bitcoin mining was about 58 percent sustainable under the definition used by the International Energy Agency, as compared to 31 percent for the U.S. energy grid as a whole. As for Bitfury specifically, our total carbon emission impact is significantly less than the carbon emission impact of the U.S. electric grid as a whole – 211 kilograms per MWh compared to 386 kilograms per MWh for the U.S. grid as a whole. This figure excludes carbon offsets purchased for one of our international locations; if carbon offsets were included under the International Energy Agency's approach, the improvement would be even better.

Bitcoin's Energy Incentives

Like any business, a bitcoin mining company seeks the lowest price for its various cost inputs – in our case, the lowest cost of energy. It is a common, but inaccurate, belief that certain fossil fuels such as coal are the lowest-cost sources of electricity production. In fact, the lowest cost of energy comes from consuming excess capacity – from any source. Thus bitcoin miners are able to add to total energy efficiency in several ways, including:

- ***Providing baseload consumption for solar and wind power generators that otherwise are unable to sell significant amounts of their production capacity.*** In 2020 in California alone, 1.5 ***million*** MWh of solar production (five percent of the total) was curtailed because production exceeded demand. And this figure understates the true extent of the problem – at certain peak production hours, California solar projects have as much as 15 percent excess capacity. This is one reason why solar and wind power as a category have generally been unprofitable and have required government subsidies. As Professors Eric Williams and Eric Hittinger of the Rochester Institute of Technology, among others, have explained in recent analyses, demand response programs that shift demand from periods of low supply and high demand to periods of higher supply are one key to profitable renewable energy production. The International Energy Agency recommends 500 GW of additional demand response by 2030. This is why solar and especially wind power developers, among others, are partnering with bitcoin miners to provide baseload consumption capacity and turn a money-losing business profitable. In short, if we want more solar and wind to be developed, we have to

harness market incentives for developers. Bitcoin mining partnerships can help do that.

- ***Flare gas capture***. A byproduct of oil drilling is the flaring of natural gas found in oil wells. Currently, that byproduct activity produces carbon emissions with no counterbalancing economic value. Bitcoin miners are partnering with oil exploration companies to turn that dead-weight loss into economic value.
- ***Reducing energy loss related to transmission and distribution***. Roughly five percent of all electricity produced in the United States is lost every year due to transmission and distribution issues. The mobility of bitcoin mining allows the industry to construct data centers close to the power generation source, thus reducing these losses and turning the associated power into economic value while also reducing the need for additional investments in transmission and distribution infrastructure.

Bitcoin's Positive Knock-on Effects

Among bitcoin's positive effects are effects felt outside of the cryptocurrency ecosystem. Among these are:

- ***Stabilization of electric grids***. We all remember the Texas blackout of February 2021. One of the causes of such events in the U.S. and

around the world is an imbalance between production and demand on the electric grid. Bitcoin mining data centers can and do adapt their power consumption dynamically to rebalance the grid upon request from the grid operator.

- ***Dramatic increases in ASIC efficiency***. Bitfury's next-generation ASIC chip, scheduled for release this year, is 6100 percent more energy efficient than its first-generation chip released in 2013. The development of new approaches to low-voltage ASIC design obviously benefits the entire computing industry, not just bitcoin mining. And at Bitfury we have developed the concept of controllable load regulation equipment that responds proactively to supply/demand.
- ***Large-scale implementation of immersion cooling systems***. By many estimates, air conditioned cooling systems account for more than 20 percent of the total energy use of bitcoin mining. This is why Bitfury developed LiquidStack, one of the world's leading immersion cooling companies. LiquidStack solutions are currently in use cooling 160 MW of data center activity. LiquidStack DataTanks eliminate almost all cooling-related energy usage in bitcoin mining data centers,

and are now being adopted outside the mining context by operators of cloud-computing data centers and other hyperscalers.

Is Proof of Work a Feature or a Bug?

It is commonly said by people new to the cryptocurrency arena that bitcoin and other proof-of-work assets are inherently less attractive than "proof of stake" assets because of their relatively greater energy consumption. While it is true that bitcoin and ether mining are more energy intensive than the validation mechanisms on proof-of-stake blockchains, their use of energy does produce valuable attributes that are not present in the proof-of-stake universe.

For one thing, the requirement of energy expenditure in proof-of-work blockchains such as the Bitcoin blockchain enhances the security of the relevant networks. This is because the expense involved in taking over 51 percent of the network's computing power – the threshold necessary to rewrite blocks of transactions on the blockchain – would be prohibitively expensive. As a result, the Bitcoin blockchain has never been hacked and no bitcoin have ever been counterfeited.

Second, the requirement of energy expenditure is one of the features that allow bitcoin in particular to maintain a credible monetary policy, which is one of the main attributes giving bitcoin its economic value. Because there is a fixed amount of bitcoin that will ever exist, increasing hashrates over time increase the

cost of winning the marginal bitcoin reward, but the associated increase in bitcoin price continues to incentivize miners to continue to maintain the network at least until the last bitcoin is mined in the year 2140.

Third, bitcoin's value goes far beyond its status as the largest cryptocurrency by market capitalization. Bitcoin is the reference asset for much of the rest of the crypto ecosystem. Many decentralized finance protocols, decentralized stablecoins, and other crypto projects rely on bitcoin as their major source of collateral or as their reference asset. As of last week, the total value locked in DeFi protocols approached $240 billion, so this is not a trivial consideration. And while bitcoin mining (which maintains what is known as Bitcoin's Layer 1 protocol) consumes energy, the enormous velocity of transaction activity that occurs through Layer 2 solutions such as Lightning adds no additional energy consumption. In short, bitcoin's market cap range over the past several months of $800 billion to $1.2 trillion significantly understates the productivity of bitcoin per unit of energy consumed – as further discussed below.

Fourth, and perhaps most important, while proof-of-stake blockchains are extremely important and valuable in the cryptoeconomy and especially in the emerging Web 3 ecosystem, only proof-of-work provides a truly trustless system of peer-to-peer exchange. Proof-of-stake is essentially an electronic means of traditional corporate governance – the shareholders with the most shares can

control the system and could in theory act contrary to the interests of other users who have smaller token holdings. Proof-of-work systems such as the Bitcoin network, by contrast, do not require trust that large shareholders will act in the interest of all.

Bitcoin is an Economically Productive Use of Energy

As noted above, the question for policymakers should not be framed in terms of the amount of energy consumed by bitcoin mining or any other potential use. In our market economy, the question is, are there more productive uses to which that energy could have been put instead?

The best ways to think about this are to compare bitcoin's economic productivity to the economic productivity in energy units of gold mining, because bitcoin is an alternative store of value; and banking, because bitcoin and its associated blockchain is an alternative platform for payments.

According to the Cambridge Bitcoin Electricity Consumption Index, bitcoin mining and gold mining consume approximately the same amount of electricity per year. Unlike bitcoin mining, however, gold mining presents a host of other environmental concerns: solid waste production through tailings and waste rock, open cut mining, chemical consumption, and pollutant emissions, to say nothing of the secondary effects of transportation and storage costs. And, as noted above, bitcoin produces a host of Layer 2 transaction effects that amplify the value of the

Bitcoin network by orders of magnitude, whereas gold does not. This would help explain Goldman Sachs's recent assessment that bitcoin likely will double in value over the medium term as its share of the store-of-value market increases to approximate the market share of gold.

Let's compare bitcoin to the economic value of other users of energy. Bitcoin uses 235 TWh of electricity to produce $1 trillion of value. If my math is correct, the aviation industry uses more than 11,000 TWh to produce the same value. The chemicals industry uses 1,349 TWh to produce the same value. The combined global financial services sector, including all of finance and insurance, consumes about the same amount of energy as bitcoin per dollar of value created.

Thank you for the opportunity to speak with you today and I look forward to the committee members' questions.