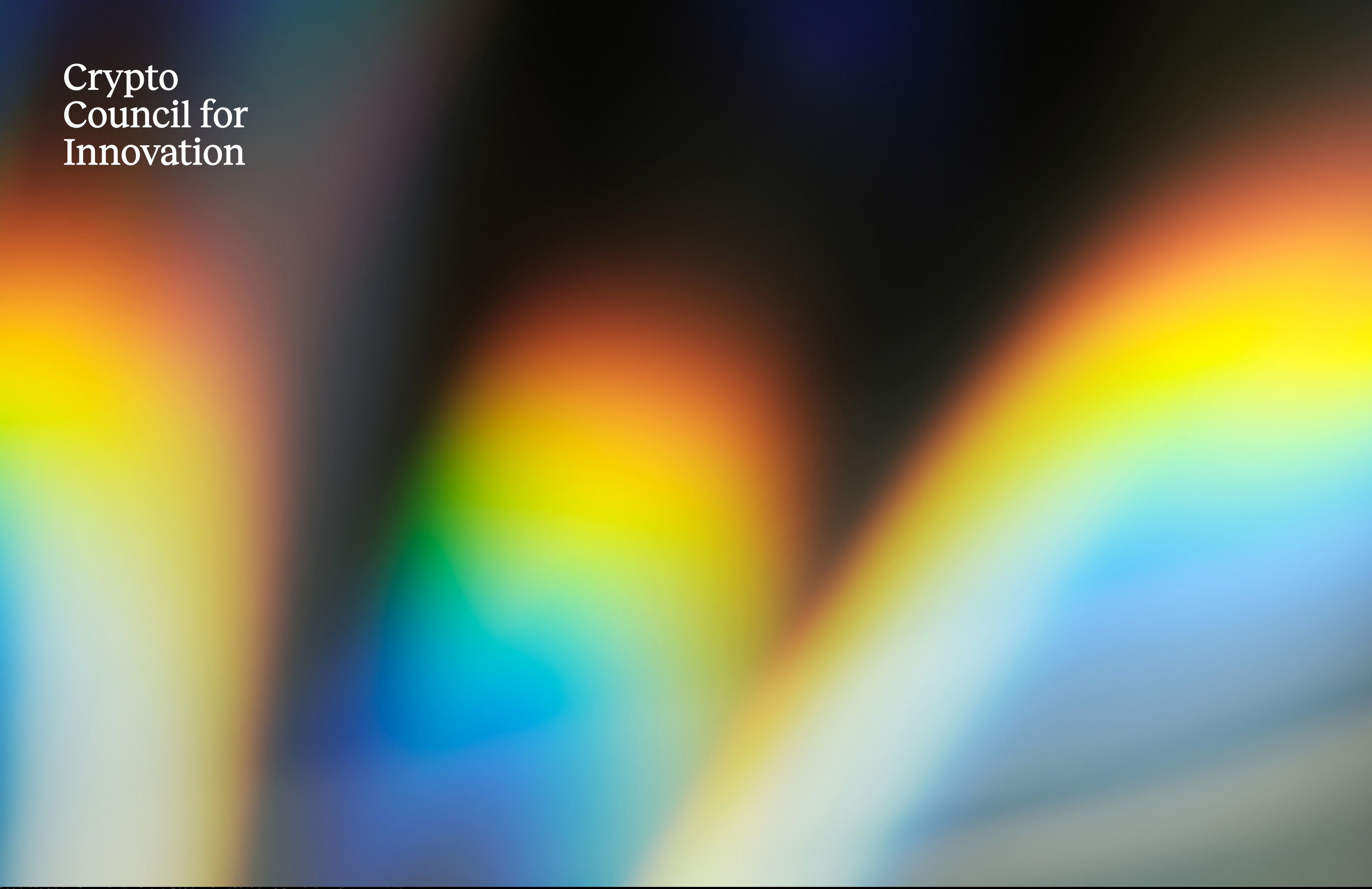
Crypto Council for Innovation



Proof of Work & Enabling the Energy Transition

Crypto Data Center Case Studies Report

Part 1 — **Working Draft**

Executive Summary

As the world transitions towards a future powered by zero-carbon energy sources, investments in energy infrastructure are critical. However, there are several challenges today that stand in the way, including grid instability, energy transmission and storage, and harmful byproducts from current energy sources.

- **Grid instability:** Renewable resources like wind and solar have a variable supply. That is, there are "*intermittency*" issues that result from the fact that these resources are sensitive to factors like time of day and weather.
- **Energy Transfer and Storage:** There is a geographic mismatch between zero-carbon energy resources and energy demand. Power generation often takes place in remote areas because they are optimal in terms of space and resource. However, energy is difficult to transfer, so it often does not get to the consumer.
- **Harmful byproducts:** There has been an increasing awareness that byproducts of energy production, such as gas flaring have significant negative environmental impacts. However, this has been a persistent challenge given that oil production frequently takes place in remote and inaccessible locations.

As a result, there are several challenges for projects focused on zero-carbon energy. To-date, the answer to mismatches in supply and demand has been curtailment, which is costly and results in wasted energy. New projects are being stalled or withdrawn due to interconnection challenges – and over 90% of requests in the US are for zero-carbon energy sources. Energy producers are being forced to sell at low or negative costs. Unmitigated gas flaring emits over 400 million tons of CO2 equivalent emissions annually.

The need for action on the energy transition is urgent – and crypto can be an important bridge to much-needed investments and market support. Crypto data centers are uniquely suited to address some of these challenges due to their unique combination of flexibility, consistency, and transparency. Specifically:

I. **Flexibility:** Numerous studies have found that a flexible load on renewable-powered grids can be a key solution minimizing the mismatch of supply and demand. Crypto data centers are flexible on two critical axes: (1) Location and (2) Demand. This means that they can access stranded sources of energy and power up and down, depending on grid conditions.

II. **Consistency:** Relatedly, sustained demand at-scale is important. Typical demand for energy varies based on several factors such as time of day, population, etc. Consequently, markets for renewable energy sources can face periods of low demand, which affects their market prices and business models. Crypto can serve as a consistent source of demand, reducing the need for costly curtailment.

III. **Transparency:** Crypto provides a new model for financial services and data centers more broadly. The transparency that the industry brings: (1) data that can be used to inform decision-making and (2) a model for greater accountability and transparency.

This paper aims to surface examples of sustainability-focused operations and provide new insights into and data behind their approaches. The case studies featured in this report represent over 20 sites across the United States, taking various approaches to sustainable operations. This includes:

- Utilizing flared gas as a power source to mitigate the effects of methane emissions – which has over 80x the warming power of CO2.
- Experimenting with new technology for cooling, which makes up an estimated 40 percent of energy consumed by data centers
- Balancing grid instability by powering data centers up or down within a 5-15 second timeframe.

- Building brand-new renewable energy sources, representing over 3 GW of added renewable energy to the grid in the long-run.

The companies in this report have made hundreds of millions of dollars of investments in sustainable infrastructure powered by local communities. They have added hundreds of jobs in areas facing the effects of industrial decline. Together, they make up over 3,000 MW of capacity designed to answer some of the most pressing challenges facing US grids today. Where energy mix data was available, they are powered by **91.1%** zero-carbon energy sources – and in some cases, have carbon negative operations.

Throughout the case studies, one thing became clear: the business models are powered by the unique properties of Bitcoin data centers. While other use cases may follow, crypto data centers had to be the starting point to make the economics work for investing in these zero-carbon energy sources. Indeed, many of the case studies featured aim to expand their businesses to scale environmental benefits – but these expansions are powered by the original Bitcoin use case.

While this paper does not focus on crypto, Bitcoin, or blockchain themselves, it is worth highlighting why this conversation matters beyond the energy transition. Crypto and blockchain technology are opening new possibilities for the digital economy. Creating options for individuals to interact and transact in a non-intermediated manner has enormous implications for digital money, data ownership, identity, and beyond. Proof of Work, the consensus mechanism that underpins the Bitcoin network, among others, was the starting point for these conversations. Its system of economic rewards design uniquely makes “cheating” expensive and incentivizes honest behavior.

This series is split into two parts: Part 1 (this working draft) provides an overview of Proof of Work, including why it matters and the features that make it well-suited to supporting a transition to a zero-carbon future; Part 2 (forthcoming) highlights case studies of the operations and business models of sustainability-focused crypto data centers and will offer policy recommendations.

Introduction

As crypto increases in value and prominence, there have been discussions about the industry's energy use, environmental impact, and approach to sustainability. These are important conversations that should happen and be approached in a nuanced and evidence-based manner. This paper aims to be a starting point for a longer discussion of the energy transition, data centers, and crypto's role in both.

Specifically, it will examine the ways in which Proof of Work data centers can fuel long-term markets for zero-carbon energy sources, creating a sustainable business model for wind, solar, nuclear, and flared gas. These projects can provide a roadmap for other data centers and the financial services industry. We hope that these findings will illustrate potential pragmatic paths forward, given that this issue is critical to so many sectors. The paper also outlines the consequences of inaction for the US innovation and climate agendas.

We underscore that the crypto industry is not asking for special treatment. Rather, there are many in the crypto industry that want to work collectively with the broader ecosystem to understand the holistic impact of data centers. It is important to approach the issue from a holistic, use-case agnostic perspective of how data centers can be made more energy efficient overall. Crypto projects are willing and able to serve as partners, and leaders, in advancing new economic and environmental models.

Finally, the conversation around energy should take a holistic approach. This requires taking a detailed and nuanced view of the ecosystem. Getting to an accurate understanding of crypto's impact requires going beyond simplified measures of energy use and accounting for the energy mix used, how it may support the market for renewables, and how the underlying technology may be used to aid climate efforts. The industry is interested in being a part of the solution and has already invested significant resourcing into research and innovation on this front.

Proof of Work and its role in the energy transition

Source: @jean-beller/Unsplash

01 What is Proof of Work and why does it matter?

Crypto and blockchain technology represent a once-in-a-generation opportunity to rethink foundational systems.

Through disintermediation, blockchain technology offers the opportunity to re-shape our current economic and social norms such as money, identity, and data management from the ground up. At its core, it is a system designed to move ownership from the hands of corporations and intermediaries to individuals themselves.

The importance of this option cannot be overstated. Trust in governments and financial institutions is collapsing. There has been a consistent trend of democratic decline and a rise in authoritarianism around the world. And, all the while, many have been left out and left behind – with gaps widening via de-risking practices, bank branch closures, and more.

Enter: a decentralized record-keeping system that allows for trust to exist in environments without the need for a third-party.

Consensus mechanisms are core to enabling this trust. Previous models involved a centralized intermediary managing a private ledger. These intermediaries served as "trust brokers," charging for service provision and acting a decision-making authority around access to and incentives within the system. History has shown that these intermediaries can represent points of failure, fraud, or exploitation.

Using consensus mechanisms, this responsibility is decentralized. Nodes that operate globally are responsible for agreeing to, updating, and maintaining a shared, publicly visible ledger. Through economic incentives, consensus mechanisms simultaneously dis-incentivize malicious behavior, by making "cheating" expensive, and incentivize honest behavior, by providing rewards to honest network operators.

The best-known example is Proof-of-Work (PoW). Under PoW, nodes within the network "work" to add new records to the ledger by conducting complex mathematical computations. The quickest receives compensation called a block reward, which includes two parts – a block subsidy for newly-minted coins and transaction fees. PoW is currently used by the Bitcoin network, the largest cryptocurrency by market cap. This enables:

I. **Openness:** Allowing anyone to join as the network to validate transactions

II. **Integrity:** Providing on-chain rewards to incentivize miners to behave in line with the shared interests of the network and disincentivize fraud

As one expert highlights, this is a revolutionary form of public infrastructure: "We have public information infrastructure for websites and email, it's called the Internet, but the only public payments infrastructure that we have is cash, as in paper money, and it only works for face to face transactions." Though exchanging monetary value was the first use case, Bitcoin and Proof of Work have opened a new world of possibilities. Conversations about central bank digital currencies (CBDCs), digital art and NFTs, and decentralized finance would not be possible without this fundamental transformation in value exchange.

Of course, this is a simplified explanation. A full explanation of consensus mechanisms and how they work is well-covered elsewhere and out of the scope of this paper. For those looking for more information on this, we recommend the following resources:

- Bitcoin: A Peer-to-Peer Electronic Cash System (Bitcoin White Paper)
- What is Bitcoin mining, and why is it necessary?

Crypto is built for the long-term. We are already seeing its immense social value in action.

Put simply, Proof of Work consensus enables new possibilities by creating new economic, governance, and social models.

Historically, costs of maintaining the security and integrity of financial services have been borne by service providers. In the case of government service provision, such as cash and settlement systems, these investments have been priced as public goods. In the case of private sector provision, these investments have been priced within their business models.

By contrast, in a decentralized model, security and integrity of the system is a collective responsibility. As with public goods, and especially global public goods, it may be difficult to approximate the total social value of decentralized consensus mechanisms. We will need new models for valuing aspects like security, inclusion, innovation, disintermediation, censorship-resistance, and the other new models that crypto and blockchain technology enable. The model would also need to be global in nature – accounting for the cross-border nature of crypto and the outsize impact in developing and emerging economies.

Its social value should also be considered. For instance, according to the 2021 Federal Reserve Economic Well-being of Households survey, 60% of individuals using crypto for transactions had an income of less than $50K. Moreover, 13% did not have a bank account and 27% did not have a credit. Those with no bank account, no credit card, and no retirement savings were more likely to use "crypto for transactions" than "no crypto." This means crypto can be a powerful tool for those who are un- or under-served by the traditional financial system.

Recent events have also shown how crypto can be used as a tool for humanitarian assistance. Shortly after Russia's invasion of Ukraine, over $100 million in crypto assets was mobilized for much-needed supplies and services. Over $1 billion was raised in crypto for COVID relief in India through a Twitter-based grassroots effort. Blockchain-based settlement and record-keeping ensured that donations could be used immediately and that the fund flows were transparent.

More broadly, crypto has been an important tool for human rights. As human rights advocates have recently highlighted, they "have relied on Bitcoin and dollar instruments known as stablecoins, as have tens of millions of others living under authoritarian regimes or unstable economies." We see this in the powerful stories coming from those who live in environments of strict financial controls, political disruption, and currency volatility. We have seen time and time again, crypto can be a critical lifeline in the face of instability. More routinely, it offers more choice to consumers in areas like remittances. We are seeing this in high levels of adoption in developing and emerging economies.

These examples only scratch the surface, and we are only at the beginning – like the internet in the early 1990s. In fact, it is no coincidence that many of the internet's earliest and most successful entrepreneurs are now involved in the crypto space. As the technology continues to develop, we anticipate even more use cases, innovation, and positive externalities.

02 What are the properties of Proof of Work that enable zero-carbon energy markets?

There are currently significant energy infrastructure challenges. These challenges are resulting in a mismatch between supply and demand – with negative impacts on new and existing projects.

The need to quickly scale up zero-carbon energy sources and associated infrastructure has been well-documented and widely recognized. States are responding in turn and investing heavily in wind, solar, nuclear, and beyond. However, the pace of adding these resources to the grid has led to several challenges.

Grid Instability

Renewable resources like wind and solar have a variable supply. That is, **there are "*intermittency*" issues that result from the fact that these resources are sensitive to factors like time of day and weather.** The sun doesn't always shine, and the wind doesn't always blow. So, the frequency and voltage of production is somewhat unreliable.

West Texas & the ERCOT Market

There has been widespread coverage of an increase in crypto data center operations in Texas. This is, in part, because the Electric Reliability Council of Texas (ERCOT) grid has unique features that enable win-win partnerships. Texas has an isolated grid, meaning that it cannot import power from neighboring areas. This makes the ERCOT grid particularly sensitive to demand spikes and grid instability. The issue is exacerbated by the intermittency of renewables.

West Texas is a particularly relevant area – it has approximately 34 gigawatts of power generation, but only 12 gigawatts of transmission. For context, ERCOT West accounted for 60% of ERCOT's total curtailments – and both wind and solar curtailments have been on the rise in the ERCOT grid as a whole. As of May 2022, ERCOT was tracking 1,017 interconnection requests totaling 199,119 MW. This includes 106,920 MW of solar and 19,544 MW of wind.

Importance of flexible loads to ERCOT

Research by energy experts found that operating flexible data centers would lead to less natural gas being built and a net-reduction of carbon emissions by 2030, when compared to a base case with no data centers and an alternative case of inflexible fata centers. The research also found that "data centers can increase the resiliency of the grid by reducting demand during high-stress times (low reserves) on the grid."

The Dallas Federal Reserve suggests that expanding such demand response programs could help prevent blackouts. ERCOT estimates that these programs will "shave 2,900-4,700 MW off peak demand in the next five years."

Energy Transfer & Storage Challenges

There is a geographic mismatch between zero-carbon energy resources and energy demand. Power generation often takes place in remote areas because they are optimal in terms of space and resource. However, energy is difficult to transfer, so it often does not get to the consumer.

The difficulty of transferring and storing energy has led to grid "congestion." Subsequently, periods where there is excess supply – especially in areas that are making significant investments in renewables. Research into increasing the efficacy of transfer and storage methods is underway, but early. For now, the math on these projects isn't adding up.

New renewables projects are being stalled or withdrawn. A report from the Department of Energy found that transmission deployments fell from an average of 2,000 miles from 2012-2016 to an average of 700 miles from 2017-2021. This is happening at a time that an increasing number of projects – especially renewables projects – are seeking to connect to the grid. In fact, a recent study found that there are 1,400 gigawatts (GW) of generation and storage capacity seeking connection to the grid. Over 90% is for zero-carbon energy sources.

In addition to the withdrawal of projects, "those that are built are taking longer on average to complete the required studies and become operational." It took 3.7 years on average for a project to come online after entering the queue – up from 2.1 years on average in the previous decade. Only 20% of wind power and 16% of solar power projects in interconnection queues have successfully connected to the grid and begun operations in the past decade.

Studies have shown that the price tag for integrating these clean energy projects will be hundreds of billions of dollars – and that interconnection represents a significant barrier for new projects. Additional work has identified a number of challenges related to the transmission construction needed for electricity system decarbonization. This includes but is not limited to: complexity in permitting between the federal, state, and local levels, difficulties with cost allocation, and the potential for local opposition. Policymakers and regulators are taking note. In the past year, there have been new initiatives such as the Interconnection Innovation e-Xchange (i2x) and "Building a Better Grid" to specifically examine and address these issues.

At the same time, existing projects are forced to limit supply and sell energy below market cost. These infrastructure issues have meant that renewable energy produced is often unable to reach the end consumer. This results in overproduction of energy, meaning that the energy is priced below market value. Some regions have even seen negative pricing, wherein it is cheaper for energy producers to pay consumers to take generation than to curtail.

Harmful Byproducts

There has been an increasing awareness that byproducts of energy production, such as gas flaring have significant negative environmental impacts. The World Bank estimates that flaring results in over 400 million tons of CO2 equivalent emissions annually. The Environmental Defense Fund estimates that methane has 80x the warming power of CO2 in its first 20 years and that at least 25% of today's global warming is driven by methane from human actions. According to Scientific American, "While CO2 persists in the atmosphere for centuries, or even millennia, methane warms the planet on steroids for a decade or two before decaying to CO_2."

However, this has been a persistent challenge given that oil production frequently takes place in remote and inaccessible locations. It is estimated that the cost of ending all routine flaring could be as much as $100 billion because of the challenges associated with capturing, storing, transporting, and distributing gas.

Crypto data centers can be flexibly co-located with "stranded" energy sources like flared gas – offering a potential mitigation strategy for this harmful byproduct. In fact, the Cambridge Center for Alternative Finance estimates that the global gas flaring recovery potential could power the entire Bitcoin network 7.8 times.

Crypto data centers offer a unique combination of flexibility, consistency, and transparency that can address these challenges.

Crusoe Energy

Crusoe Energy is a clean computing infrastructure company that powers its data centers using otherwise flared gas, a wasted byproduct of oil production. In oil fields across the United States, natural gas is wastefully burned in open flares where gas pipeline infrastructure is not available or when gas transportation capacity on existing pipelines is constrained or delayed. More than 140 billion cubic meters of natural gas is flared around the world annually, enough to power the entire Bitcoin network many times over if captured and used. The United States is the fourth largest flarer of natural gas behind only Russia, Iraq, and Iran.

Crusoe co-locates its digital flare mitigation systems directly on oil well pads to convert flared gas into computing power. Each system captures approximately 300,000 cubic feet of natural gas per day, powering modular data centers with about 1.8 MW of computing load. Given that each site is different, they operate in a flexible manner and can add as many systems as needed for a given site. Currently, Crusoe operates over 120 data centers across Colorado, Montana, and North Dakota. The team has announced plans to expand into New Mexico and Texas. In total, their systems have prevented more than 4 billion cubic feet of natural gas flaring.

Crusoe's digital flare mitigation systems include power generation equipment, electrical and computing equipment, and the modular data centers themselves – the latter of which are manufactured by Crusoe in the Denver area. Crusoe directly manages the transportation, logistics, installation, commissioning and operation of its systems with a team of nearly 300 employees. Crusoe's modular and mobile flexible design and the data centers' ability to operate via satellite and other wireless internet connections, means the operations can be located anywhere – a key feature for mitigating flaring in remote locations.

I. Flexibility

Numerous studies have found that a flexible load on renewable-powered grids can be a key solution minimizing the mismatch of supply and demand. In fact, the California ISO states: "green grid reliability requires flexible resource capabilities." Crypto data centers are flexible on two critical axes: (1) Location and (2) Demand.

Because of the interconnection and storage issues, a data center that is flexible on location can capture "stranded" energy sources. This means that energy that might be otherwise wasted or curtailed can go towards sustainably powering crypto data centers, providing a market where there otherwise would not have been once. Accordingly, research has found that dispatchable data centers reduces stranded power and improves grid cost and stability. This is also important for the economic and social impact of these data centers, as they provide jobs and local revenue in areas that are often feeling the impacts of industrial decline.

Intermittency challenges with renewable energy sources mean that flexible demand is critical as well. Crypto data center operations can be started and stopped in a unique manner – meaning they have an interruptible load. Recognizing this need, grids have set up demand response (DR) programs to smooth demand. Using contractual curtailment, crypto data centers can reduce their demand when power prices are surging, helping to alleviate potential pressures on the grid. In fact, the International Energy Agency found "500 GW of demand response should be brought onto the market by 2030 to meet the pace of expansion required in the Net Zero Emissions by 2050 Scenario (NZE), a tenfold increase on deployment levels in 2020."

II. Consistency

Relatedly, sustained demand at-scale is important. Typical demand for energy varies based on several factors such as time of day, population, etc. Consequently, markets for renewable energy sources can face periods of low demand, which affects their market prices and business models. Research shows that renewable energy sources may not be economically viable as standalone operations but could be through integration with data centers like those used in crypto.

III. Transparency

Crypto provides a new model for financial services and data centers more broadly. The transparency that the industry brings: (1) data that can be used to inform decision-making and (2) a model for greater accountability and transparency.

We have seen that measuring energy use for something as complicated as money can be challenging – for example, one analysis of the banking system's energy usage looks at banking data centers, bank branches, bank ATMs, and card networks. Their assessment, which finds that Bitcoin has lower estimated energy consumption than the banking system, excludes clearinghouses and other aspects of the financial system. Overall, this is an area that has been relatively under-studied to-date.

"How Green is the Greenback? An Analysis of the Environmental Costs of Cash in the United States" by the Fletcher School at Tufts University found that the environmental impact of cash in the United States exceeded that of Bitcoin by a factor of almost 10 – $12.9 billion USD versus $1.3 billion, respectively. As the calculations highlight, cash production involves several environmental costs including water, electricity, fuel, and sludge. Importantly, these measurements do not account for the aggregate global footprint of cash, just one country. This supports conclusions from studies of the environmental impacts of cash and debit card payments in the Netherlands, which both found that there were significant environmental impacts from operating the systems.

Still, academic literature has suggested that the unique combination of decentralization, interconnected autonomy, openness, and intelligence makes blockchain technology a key enabler of a variety of energy-related use cases. These include peer to peer energy transaction, efficiency gains in electric vehicle charging, carbon emissions certification and trading, synergy of the multi-energy system, and more.

As crypto grows and represents a larger share of assets, the financial system will become more measurable over time. Analysis of the real-time and transparent data that crypto provides will help take educated steps towards energy efficiency and a greener future.

03 How can Proof of Work data centers serve as a "bridge" for the market?

Given the current infrastructure challenges and long-term view of Proof of Work data centers, crypto can serve as a critical "bridge" for the market.

While programs aim to build this critically needed infrastructure, crypto data centers are available to provide an economically aligned market for these resources. Investment in renewables is needed urgently – and the flexibility of crypto data centers can fill the void.

There are two main categories of sustainability-focused operations:

- **Front of the meter:** Front of the meter approaches are grid-connected, meaning that resources are passed through an electric meter. Renewables are then purchased from the grid. These data centers add demand for renewables to the grid.

- **Behind the meter:** Behind the meter approaches are connected to a generation facility. This includes facilities that utilize energy from on-site generation and alternative approaches such as flared gas-powered data centers.

These approaches can be complementary.

Crypto, especially Bitcoin, can be a bridge asset for early-stage investments. If the U.S. wants to remain a leader and meet ambitious climate targets, time is of the essence. Large-scale investments and a reliable market for renewables is needed *now*. As this paper demonstrates, the technology and willingness are available to support this need.

This is particularly relevant given that the incentives of the network are due to change every time. The reward for mining Bitcoin halves approximately every four years – and the supply is capped at 21 million Bitcoin. Both factors will affect the energy demand of crypto data centers over time.

Experimentation Across the Lifecyle: Immersion Cooling

Estimates suggest that up to 40 percent of energy consumed by data centers – both within and outside of crypto – goes into cooling. As such, some data centers have been looking into this aspect as a mechanism for mitigating climate impacts. One approach: immersion cooling.

Immersion cooling technology has been used by miners for almost a decade, though it has increased in popularity with crypto data centers relatively recently. Under this model, machines are immersed in flowing synthetic oil that is designed to absorb machine-generated heat. Though the machines are designed for air cooling, but a company called CleanSpark removes the fans and opens the unit, so that the fluids can flow across the systems.

This is instead of an air-cooled approach, which uses fans. Research comparing air cooling and immersion cooling found "a reduction of about 50% in energy consumption and a reduction of about two-thirds of occupied space."

CleanSpark uses immersion cooling as a mechanism for increasing the efficiency and lifespan of hardware. The company estimates that this approach – in combination with adding software that allows the equipment to "overclock" – allows for 20 percent more hashpower than average rates at their Norcross facility. CleanSpark also estimates that this approach extends the life of a miner from five years to seven years.

This is also designed to reduce noise. As one journalist who visited a CleanSpark site noted, "The first thing you notice about CleanSpark's new 20 megawatt immersion mining facility in Norcross, Georgia: It is not loud."

Watch more: CleanSpark has published behind-the-scenes videos of immersion cooling and facility operations.

04 How does this compare to alternative proposals?

Policymakers and others have offered various proposals for mitigating climate effects of Proof of Work data centers. Notable examples include a Proof of Work ban and switching to an alternative mechanism like Proof of Stake.

I. Proof of Work bans will have unintended consequences.

Recent academic research showed that actions taken by China to ban Bitcoin data centers worsened its environmental impact – increasing its carbon intensity by 17%. This is unfortunate, given that crypto data centers' flexibility allowed them to consume excess hydroelectricity during Sichuan's rainy season.

Moreover, these efforts were not effective in curbing this activity. New data from the Cambridge Centre for Alternative Finance showed that the quelling effects of the ban were temporary, with data center activity re-surging following a short gap.

II. A transition to an alternative consensus mechanism takes research and time.

Some have suggested that a shift to an alternative consensus mechanism is a potential avenue for reducing the environmental impact of crypto data centers.

Developer ecosystems are proceeding with caution in crafting these advancements and shipping them to the main networks. For instance, the Ethereum network's shift to Proof of Stake was a years-long process – starting in 2015. "The Merge" over one hundred developers (working across the world) and a large research and development budget. Implementing protocol-wide changes does not happen in the way that it might with centralized companies. There are rounds of community feedback, international collaborations among developers, and governance via open processes. Given the market caps of Proof of Work cryptos, caution is key. If the transition does not go as planned, it could lead to devastating losses for consumers within the ecosystem.

Conclusion

We are on the precipice of an important energy transition. There are many in the crypto ecosystem who deeply understand today's challenges and want to be a part of the solution. And, many who came from an energy background and saw crypto as the way to make progress on some of the toughest issues in their sector.

Concerns about environmental impact are important and this discussion is critical to accountability. As discussed within the paper, industry players are actively investigating ways that the technology may be leveraged to help climate change efforts. However, it is critical that the industry isn't arbitrarily punished for its unique transparency.

This should be viewed as a tool to facilitate a system that is more accountable and sustainable than ever before. As crypto grows and represents a larger share of assets, the financial system will become more measurable over time. Analysis of the real-time and transparent data that crypto provides will help take educated steps towards energy efficiency and a greener future.

Rather than turning to reactive policy proposals that could have adverse consequences in the long-run, it's important to take a long-term outlook and consider the unique properties of crypto data centers that can make them an important player in fueling investment, experimentation, and progress in the clean energy space.

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Questions?
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