

Flared Gas Can Reduce Some Risks in Crypto Mining as Well as Oil and Gas Operations

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Abstract: There are numerous risks associated with mining and owning cryptocurrencies, and exploring and producing oil and natural gas are highly risky, costly, and controversial. A marriage of digital mining and exploring and producing oil and natural gas has reduced the major risks and costs for both the crypto miner and the petroleum industry. On the one hand, crypto mining requires an enormous amount of electricity, which is not environmentally friendly. On the other hand, when drilling for petroleum resources, natural gas is often discovered, but due to a lack of resources or pipeline availability, a massive amount of natural gas is vented into the atmosphere or burned (called flaring). Today, however, this normally wasted gas (called stranded natural gas) is being used to create cheap electricity for mining server containers stationed near drilling rigs, which are used to create cryptocurrencies. This results in reduced CO₂ emissions, lower costs for drillers, and greater royalties going to landowners.

Keywords: cryptocurrency; crypto mining; crypto flaring gas mining; gas flaring; blockchain; stranded natural gas



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Exploring and producing oil and natural gas are highly risky, expensive, and controversial activities. Among these risks are the enormous drilling costs and the probability of finding little or no commercial quantities of hydrocarbons. Environmental factors cause increased regulations, and a portion of the public has turned against fossil fuels as governments push for solar and wind energy. There are calls to ban the fracking process—which itself requires an enormous amount of water—and even to close pipelines. If natural gas is found, there must be a pipeline to transport the gas; otherwise, as much as 40 to 60% must be vented or flared. Overcoming this issue, recently, a marriage of digital Bitcoin mining and exploring and producing oil and natural gas has reduced the risks for both the crypto miner and the petroleum industry.

1. Two Major Risks

There are two major risks to cryptocurrencies. First, [Mikhaylov \(2021\)](#) indicated that private money such as a cryptocurrency may leave governments vulnerable to devaluation of their currencies and increase competition between private and public money.¹ To avoid such a scenario, governments may ban or limit private currency and develop their own central bank digital currencies (CBDCs) to stabilize their monetary independence. At least 105 countries (over 95% of global GDP) are exploring central bank digital currencies ([Helms 2022](#)).

At least 50 countries have bans or restrictions on cryptocurrencies, such as China, Egypt, Turkey, and others. China used the 2022 Winter Olympics in Beijing as an international test of their CBDC, which they have been testing since 2019.

Without taking a position, on 4 February 2022, the U.S. Federal Reserve released a white paper pointing out the risks and benefits of a U.S. CBDC dollar, or Fedcoin. This report indicates that the Federal Reserve will not issue such a digital currency until the

benefits outweigh the risks. The stated risks include banking disintermediation, the threat to the stability of the financial system, and complications to monetary policies. Nine countries have launched retail CBDCs, and 14 other countries are piloting such projects (Boucher et al. 2022).

Yakovlev et al. (2021) suggested a second risk to cryptocurrencies is the capital flows from “brown” economy sectors to green ones when we move from climate change debates to the implementation of specific measures (see also Kramina 2021). This paper does not discuss the risks associated with countries creating their own CBDCs and banning private money. Instead, the goal is to demonstrate how flared gas can be used to reduce the climate risk posed by the energy requirement for crypto mining. The risks from fraud and a lack of accounting standards around cryptocurrency transactions are also briefly discussed.

2. Background

The creation of digital currency in 2009, known as cryptocurrency, was an astronomical turning point for businesses and investors. Today, transparency, low fees, and identity safeguards are enticing factors that support cryptocurrency’s booming popularity in the oil industry. Bitcoin is a new-age version of a no-coupon bond issued at a 99% discount with the network effects of a tech company (Myers 2022).

Countries including the United States, China, El Salvador, Canada, and Norway are jumping onto the Bitcoin bandwagon. Wyoming, North Dakota, Montana, New Mexico, and Texas are among the American states attempting to cut energy costs by relying on Bitcoin mining (Baker 2021). Since 8 June 2021, Bitcoins have had the status of legal tender in El Salvador, and they are building a Bitcoin City at the base of the Colchagua volcano to take advantage of the volcano’s geothermal energy. Estimates are that the new El Salvadorian digital wallets will cost the Western Union and other companies USD 400 million a year. A virtual currency wallet (akin to a fancy flash drive) holds a person’s virtual currency. This experiment in a developing country should indicate if other countries can convert to a digital currency. Elsewhere, China has banned all international cryptocurrencies and crypto mining but tested its digital yuan at the 2022 Winter Olympics.

In association with crypto mining, miners and producers in the oil and gas industry are cutting energy costs by profiting from flared natural gas, which is normally wasted. Miners argue that this new type of crypto mining is environmentally beneficial as it takes advantage of valuable resources and transforms them to have a use, thereby decreasing waste. However, these practices are condoned by environmentally conscious stakeholders, who argue that they support the continuing high use of electricity for crypto mining.

Looking ahead, the introduction of digital currency must be accompanied by new accounting, taxes, and security standards and regulations. Accordingly, regulating bodies have begun advising accountants to be vigilant when it comes to their clients’ crypto assets, to ensure their proper accountability and reporting. It seems that cryptocurrency may represent a steppingstone toward the future of the oil and gas industry, along with the rise of the crypto industry.

3. Cryptocurrency Mining in the United States

When drilling for petroleum, oil companies often discover associated gas, commonly referred to simply as natural gas. This excess gas (called stranded gas) is flared or burned due to the lack of resources and infrastructure needed to sell it properly (Robertson 2021). Oil can be trucked from a remote location, but gas requires a pipeline. World Bank studies suggest that “5.3 trillion cubic feet or 150 billion cubic meters of natural gas is flared annually, which amounts to 25% of the total consumption of the United States” (Tassev 2019). Research shows that natural gas represents 60% of the Earth’s energy reserves, which means crypto miners have ample opportunity to use this flared gas sustainably for crypto mining in the years to come.

Crypto flaring gas mining is the process of transforming excessive natural gas into energy to mine cryptocurrency or virtual coins. The stranded gas, which is otherwise

burned, can be used to power electricity to servers in mobile containers stationed on drilling rigs that create cryptocurrency. Cryptocurrency is a digital, decentralized form of monetary exchange in which many people invest. As popularity soars, it is estimated that “0.21% of all the world’s electricity goes to powering bitcoin farms—roughly the amount of power Switzerland uses in a year (Ashford and Schmidt 2022)”. There are thousands of distinct types of cryptocurrencies such as Bitcoins, Bitcoin Cash, Litecoin, Ethereum, and Ripple. Since Bitcoins are the dominant cryptocurrency leader, the flaring process could have a major effect on Bitcoin mining.

4. Conversion Process to Crypto Mining Energy

Natural gas is a byproduct of oil drilling, but without a pipeline the gas normally is vented or flared. Before being stored in tanks, natural gas must be in a liquid state at -260 degrees Fahrenheit (Gerasymovych 2021). The conversion process begins by vaporizing the natural gas. The high pressure from the steam spins a turbine connected to a generator creating electricity. Finally, this electricity is used for electric generators in crypto mining containers to mine cryptocurrency.

5. Cryptocurrency Containers

Mining servers convert Bitcoin transactions into blocks, also known as the blockchain. Bitcoin and most other cryptocurrency can be mined in a local household, but when mining cryptocurrency, a larger quantity of resources is required. A successful competitor in the cryptocurrency industry requires special high-performance hardware to have an advantageous hand in the algorithm that is used to “win” Bitcoins (Carroll 2021). The need for specialized equipment also requires higher energy use. Mining companies face various challenges to keep the containers at their prime including maintenance, restoring rigs, frozen fuel pumps, and reliable internet connections.

The most common virtual currencies to mine are Bitcoin and Ethereum. The cost fluctuates depending on economic factors, including the pandemic, electricity prices, and the producing country. In June of 2021, for the average household user, it was estimated that 1544 kWh of power is needed to create one Bitcoin. To simplify, one Bitcoin would equal USD 200 (Gonzalez 2021a). In May of 2021, Bitcoin’s hash rate (or mathematical process) used in bitcoin mining to solve the puzzles was estimated to cost miners between USD 15,000 and USD 19,000 (Ling 2021). Keep in mind that only the successful miner receives the current reward of 6.25 BTC for solving the puzzle.

The reward earned by Bitcoin miners changes roughly every 4 years, or after every 210,000 are mined. This process is called halving, and last occurred on 11 May 2020. Theoretically, the supply of Bitcoins is limited to 21 million Bitcoins that cannot change. As of August 2021, 18.77 million Bitcoins have been mined (around 2.3 million left). This factor may have caused the price of Bitcoins to increase to a high of USD 64,000 in April 2021 (from USD 3867 in March 2020).

Miners have turned towards mobile mining units to increase their crypto assets. Containers vary in sizes from 20 ft to 40 ft, dependent on the business need and how many miners are needed for the operation. The arising popularity of cryptocurrency resulted in the increased difficulty of the algorithmic puzzles required to “win” the digital medium. Normal processors or CPUs were inefficient for crypto mining, prompting users to discover GPUs, or graphical processing units, that would be more capable of solving the problems (Arora 2021). Due to the advanced computers and electricity necessary, containers include ventilation systems, hundreds of air conditioners, and even dust filtration systems (Cryptocurrency Containers—What Is Bitcoin Mining? 2021). Mining containers are the golden ticket for companies such as Crusoe Energy, O’Connell Electric, Ecoark Holdings Inc., Argo Blockchain Plc, Capstone Leasing, and EZBlockchain.

Essentially, the puzzle is to verify the transactions that are occurring on the blockchain. Miners are performing the duties of an auditor to prevent fraud by ascertaining the legitimacy of all of the Bitcoin transactions. Once enough transactions are certified, a new block

is added to the blockchain. To ensure no one auditor–miner controls 51% of the blockchain (and becoming a possible fraudster), the hash rate is moved upward to create difficulty. Increasing the difficulty decreases the risk of fraudsters controlling the blockchain. Figure 1. shows the price history of Bitcoins and the rising mining difficulty in the past few years in comparison to the mean hash rate.

The hash rate in Bitcoins measures how many miners are processing transactions and mining new virtual coins. Every transaction in the Bitcoin network must be added to the blockchain. The miners estimate the alphanumeric code (e.g., hash) which represents the transaction’s data. Once verified, another block is added to the blockchain.

Bitcoin: Mining Difficulty vs. Bitcoin: Mean Hash Rate



Figure 1. Source: Glassnode (Gans 2021).

6. Producing Companies

Crusoe Energy, a Denver-based company with around 40 mobile units, is undoubtedly one of the biggest leaders using flaring Bitcoin mining. They estimate that 63% of CO₂ emissions can be reduced by their systems due to gas flaring, in turn benefitting 1700 vehicles (Boucher et al. 2022). O’Connell and Ecoark are other companies engaged in flaring crypto mining. Figure 2 shows Crusoe Energy’s flare-mitigation center in Montana.

A piping system is installed on the well site to divert the natural gas into generators to create electricity to operate the numerous computers to mine the cryptocurrency. Similar to a commercial or residential gas or propane generator, the mobile stations convert the venting gas into electrical energy to operate the mining computers. The stations capture the power of motion and turn it into electrical energy by forcing electrons from the methane gas through a circuit to produce an electrical current.

In 2018, Atlas Holdings LLC partnered with O’Connell Electric to explore the Greenidge Generation Holdings’ mining plant in New York. O’Connell Electric originally developed a USD 65 million gas project to provide the proper electrical infrastructure in preparation for Bitcoin mining rigs. After the initial mining rig installations, the companies realized the rigs’ noise levels surpassed the allowed decibel levels (Maloney 2020). The unexpected mishap prompted Atlas and O’Connell to successfully veer their power through mini-substations.



Figure 2. Crusoe Energy's Flare-mitigation Center in Montana.

There are two major approaches for using flaring for crypto mining. In the “pay for the gas” approach, the Bitcoin mining company pays for the collected gas used on the oil well site (e.g., Crusoe Energy, Inc., Denver, Colorado, USA). Under this approach the miner backs up a mobile trailer carrying pipes, generators, and computers on the drill site and uses the less profitable, stranded natural gas to power their crypto mining activities (Baker 2021). In cold areas, the supercomputers produce up to 160 degrees Fahrenheit of heat to keep the workers warm.

Another approach for flaring gas mining is a “pay for the equipment” approach. For example, EZBlockchain provides a fully equipped mobile data center and electric generators (called a smart box) to the drilling company and gives the earned cryptocurrency to the driller. EZBlockchain receives rental and service fees from the driller (Baker 2021; Gerasymovych 2021). There is a reduction in CO₂ emissions, and the landowners receive more royalties. Moreover, North Dakota and Wyoming now provide a tax credit to petroleum companies that adopt a flaring gas mitigation system. A 2014 FINCEN memo indicates that Bitcoin mining is not considered to be a “money transmitting business”. The user may use the mined virtual currency to purchase real or virtual goods and services.

Ecoark Holdings Inc., a Texas-based company, is attempting to move into the crypto mining industry except with a different business approach. Along with other companies, Ecoark is striving for the reduction of environmental emissions, though their methods do not include using flared gas in comparison to other companies. Ecoark's reason on straying away from using flared gas stems from the additional factors associated with converting the natural resource including lack of oversight, personnel, and surface issues (Davis 2021). Ecoark is in beta testing of their “modularized infrastructure approach” which will allow them to create mobile market hubs. These mobile market hubs will ease pipeline constraints and create further revenue in their cryptocurrency mining process (Arora 2021).

7. Cryptocurrency Mining's Perfect Timing

The upward trend in digital asset mining could not have come at a better time for cryptocurrency supporters. The digital currency platform market had crashed in 2018 and shareholders were desperate to keep it alive (McDonnell 2021). The crypto world was shocked when Elon Musk, CEO of Tesla, announced that he would no longer support the use of fossil fuels to support his business, pushing the company to no longer accept Bitcoins for vehicle purchases and causing a 14% stock drop in the cryptocurrency leader.

Others chimed in support of Musk's comments, stating the produced energy could be used for more important entities such as hospitals or schools (Kearney 2021). As American business leaders turned to more ethical practices, beliefs that gas should be used for a greater purpose arose (Gans 2021).

Bitcoin's price was plummeting once companies, for example banks, began drifting away from accepting or using cryptocurrency. Influential leaders' criticism of Bitcoin, such as Musk's, only aided the downfall of Bitcoin's stock and prices. In January of 2021, the price of Bitcoin dropped to a record USD 30,000 (Pound 2021). Ethereum also suffered a 40% drop coming in at below USD 2000.

The COVID-19 pandemic was a redeeming feature for digital assets. With China's banning Bitcoins and other virtual currencies, the U.S. is becoming a major player for crypto mining. Stimulus payments disbursed to Americans created a booming opportunity for U.S. mining companies and worldwide (Sigalos 2021). A study found that USD 40 billion of stimulus checks were used to buy Bitcoins and stocks, with a higher spending emphasis on Bitcoins (Bambrough 2021). Based on the possibility of rising interest rates, analysts also believe that increasing inflation levels will have the opposite effect and surge buying activity into the U.S. economy to fuel mining (Seeking Alpha 2021).

8. Positive and Negative Results of Crypto Mining

With consumers and stakeholders becoming more environmentally conscious, there has been debate whether Bitcoin mining is helping the environment or if ambiguous underlying harm is caused. Stakeholders argue that energy costs, climate change, and damage to land aftereffects are not often spotlighted. Supporters, however, argue that they are helping the environment, reducing resource waste, and wasting less energy.

During drilling and before flaring, the released gas called CH₄ (or methane) is harmful to the environment and contributes to climate change. Methane gas is 28 times more damaging to the Earth's atmosphere when compared to carbon dioxide and over 20% of the planet's warming can be traced to methane gas (Borunda 2019). As previously mentioned, oil and gas companies are reducing the emissions from flaring the gas by converting it to CO₂ and turning it into electricity. Locals in upstate New York are protesting flaring, stating it is polluting the air and heating Seneca Lake, which is harming the animals that inhabit the area (Morgenson 2021).

Limetree Bay Refinery, located in St. Croix U.S. Virgin Islands, came under scrutiny when their operations resulted in petroleum rain on residents twice in three months (Eilperin 2021). The Environmental Protection Agency revoked the company's permits and is currently investigating whether the incident "poses an imminent risk to people's health (Bambrough 2021)". However, oil companies such as Crusoe Energy are leading by example. The company has introduced their "Digital Flare Mitigation" program that has other oil and gas companies interested in implementing similar practices. Crusoe's digital flare mitigation program involves portable, on-site systems, which are described as follows:

Crusoe's solutions are designed to eliminate the need for flaring as well as venting. The company uses EPA-certified emission control technology and catalytic converters to significantly reduce emissions compared to flare exhaust streams. For example, they estimate that it can reduce methane emissions by up to 95% (Seeking Alpha 2021).

Crusoe is giving hope to emission concerns with their natural-gas-powered Bitcoin mining by serving as a decarbonization solution.

An argument that stakeholders bring to the table is the massive amounts of electricity that Bitcoin mining consumes. However, the more energy mining rigs consume, the faster the Earth's fossil fuels will be depleted. Even with the introduction of more eco-friendly gas flaring, consumers are yet to support the enormous electricity amounts associated with crypto mining containers. Miners are stating that natural gas used on site, however, is essentially free, in part due to no transportation costs (Oilman 2020). Analysis shows that, "the environmental impact per miner will shrink if mining equipment becomes more efficient, use of renewable energy sources increases, or miners relocate to cooler

climates, where less energy is needed to cool the computers ([American Chemical Society 2019](#))". There has also been input about the possibility of implementing alternative energy sources such as solar and wind, which can energize a Bitcoin network by over nine times ([Kiger 2021](#)).

The need for renewable energy has led to the creation of Crypto Climate Accord (CCA). The CCA was created by numerous companies and individuals with goals to decarbonize the cryptocurrency industry by 2040 and make energy consumption 100% renewable by 2025 ([Crypto Climate Accord n.d.](#)). The CCA plans to introduce green Bitcoin hash rates, green Ethereum, crypto energy and carbon accounting good practices, proof of green ESG reporting, procurement and good practices for crypto energy and carbon offset ([Eilperin 2021](#))". Ethereum, the second-largest cryptocurrency behind Bitcoin, is currently working on a proof-of-work (POW) computer that will reduce the energy consumption amounts. Ethereum's computers will "randomly select to create blocks for the blockchain, while computers that were not selected will validate those blocks created ([Tassev 2019](#))". Under Bitcoin's POW, the miners are competing with each other to verify the transactions.

There also has been minimal debate about the costs attributable to Bitcoin mining, which ranges in the thousands of USD. Ethereum can be mined without the excessive costs of an oil rig, which is prompting the question of why the money cannot be deposited into something for the greater good, or used to develop a more cost-effective crypto ([Hamilton 2021](#)).

9. Risks for Investors and Owners

There is the obvious volatility risk for investors and owners of cryptocurrencies. Bitcoin's price on 1 January 2021 was USD 29,388, moving to USD 62,624 on April 14, down to USD 29,789 on July 20, up to USD 66,938 on November 9, but down to USD 42,171 on 18 February 2022. However, even with this roller coaster ride, Bitcoins were up around USD 19,500 in 2021. Bitcoin traders with 100× leveraging may be driving these wild swings in cryptocurrencies. A market with high volatility is not a safe market for leveraging. For example, a movement of 5% in the wrong direction could cause liquidation of a 20× leveraged cryptocurrency position.

Timothy Peterson indicates with 100% confidence that Bitcoin prices have been fraudulently manipulated at some point in its lifespan since 2010. He asserts with 95% confidence that Bitcoins were manipulated in 2013, 95% confidence they were manipulated in 2018, and 98% confidence they were manipulated in 2019. He believes that this manipulation and volatility have increased Bitcoin's value by as much as 40% ([Peterson 2021](#)).

Cryptocurrencies losses can be broken into three major tax categories—casualty losses, theft losses, and investment losses. Casualty losses include lost wallet access, transactions sent to wrong address, and a computer is lost or crashes. Theft losses occur when an exchange is hacked² or a wallet is hacked. An investment loss includes an initial coin offering scam or an exchange shutdown. For the first two categories, there is no tax casualty loss deduction available, and availability of an investment loss deduction is unclear ([Brooks 2022](#)). Even the inventor of Bitcoins, the anonymous Satoshi Nakamoto who has around USD 55 billion of the original Bitcoins, may have lost his private key or died without leaving his valuable key to anyone.

Miners are not the only individuals taking advantage of the Bitcoin mining rage. Bitcoin mining has presented an opportunity for hackers to steal information and energy from thousands of machines. Crypto jacking is, "the unauthorized use of a persons' computing power to mine cryptocurrencies" which has become a problem costing miners thousands of USD ([Nadeau 2021](#)). In the U.S., crypto jacking was at an all-time high in the early fourth quarter of 2017 through the end of the first quarter of 2019, before diminishing for the next 2 years ([Cimpanu 2020](#)). In 2021, cyber-attacks also have resurfaced, with 432,171 attacks in the first quarter alone ([Cryptojacking Scams are on the Rise Once Again 2021](#)). Surpassing the hijacking of data, crypto jacking scams can use up to 70% of a single computer's resources, causing overheating and sometimes causing the computers to catch

on fire (Thurman 2021). In China, a man was arrested after being caught stealing electricity from an oilfield that was mining crypto. The suspect hid cables in a fishpond to siphon energy away from the rig, resulting in a USD 7000 loss (Osborne 2019).

Another fraud scheme is called “pump-and-dump” where crypto influencers are paid to market a specific cryptocurrency to their followers to raise the value. Pump-and-dump schemes are illegal for stocks but not for cryptocurrencies yet. Once the virtual currency rises, influencers and scammers sell their currency and keep the profits (Gonzalez 2021b). The SEC has acted against some pump-and-dump schemes. In 2014, Chimera Energy, a shell company created by Andrew Farmer, claimed the fictitious company had developed technology to extract shale oil without fracking. The SEC charged four individuals in this type of fraud scheme (United States Securities and Exchange Commission 2014). The FBI has a new Virtual Asset Exploitation Unit with crypto security experts to fight cryptocurrency crimes.

Beginners should stick with a couple of accounts with the top five exchanges and always verify, verify, and verify. ‘Buyer beware’ should be an important slogan to help mitigate the risks associated with digital assets. Does the exchange or digital currency have “know your customer” (KYC) and anti-money laundering (AML) protocols?

10. Cryptocurrency and Accounting

The rise in cryptocurrency has also increased the need for accountants to account for such intangible assets on “the books”. As of November 2021, cryptocurrencies are not on the Financial Accounting Standards Board’s (FASB) agenda except for information gathering. Their position appears to be that the wide variety of virtual currencies complicates the problem of setting accounting and disclosure standards for them. The Board is trying to determine if the investment by companies has become pervasive (Freedman 2021). However, some companies want the FASB to issue rules on digital assets and energy transactions such as renewable-energy credits and carbon off-set credits (Maurer 2021).

The International Financial Reporting Standard Interpretations Committee takes the position that crypto assets are not financial assets but meet the definition of an intangible asset under International Accounting Standards (IAS) 38 (if not held for sale) or IAS 2 if held for sale as inventory. If held as inventory for sale or consumption, the initial measurement is cost, followed by lower of cost or net realizable value (EY 2019).

Lacking guidance from FASB, the American Institute of CPAs (AICPA) and Chartered Institute of Management Accountants (CIMA) provide a nonauthoritative *Practice Aid: Accounting and Auditing of Digital Assets in 2019*, with two supplements. The Aid suggest treating digital assets as indefinite-lived intangible assets under FASB ASC 350-30-1 at cost (Intangibles—Goodwill and Others). The Aid also makes these suggestions:

- Treat a receipt of a digital asset as a form of noncash consideration.
- Test for impairment at least annually and not subject to amortization.
- If impaired, impairment loss recognized.
- If cryptocurrency recovers, do not mark up.
- Perform impairment testing for batches of digital asset units with the same acquisition date and the same carrying value.
- Pick a rational and reasonable method for selecting the units sold and apply it consistently (e.g., first-in, first-out) (Association of International Certified Professional Accountants 2022).

The practice aid is the closest thing in place to help audit and account for digital assets that is available to the public for guidance.

Under Japanese General Accepted Accounting Procedures (GAAP), if a virtual currency has an active market and is held by an entity but on its own behalf, the measurement at the balance sheet date is mark-to-market. Any difference between cost is recognized as a gain or loss at the end of the year. If not on an active market, use cost amount. If the disposal value is less than cost at year end, the virtual currency should be measured using the estimated disposal value. Write-downs should not be reversed in future years. Japanese

GAAP indicates that virtual currency is a new, independent category of assets and are not intangible assets.³

MicroStrategy's 2020 annual report accounts for its digital assets as indefinite-lived intangible assets, at cost, net of impairment losses incurred since acquisition. Once written down, the new cost basis cannot be adjusted upward for any subsequent increase in value. Their external auditor, KPMG, wrote a critical audit matter statement about their crypto financial statement position. Square Capital also shows their digital assets as intangible assets. Galaxy Digital Holding's 2020 annual report uses the equity method of accounting. Under this method, their investments are initially issued at cost and subsequently adjusted for its share of the profit or loss.

The Financial Crimes Enforcement Network (FINRA) and the SEC have issued alerts to investors of buying risks and frauds with virtual currency-related investments. The Chairwoman of the House Committee on Financial Services, Maxine Waters, organized the Digital Assets Working Group of Democratic Members with the passing of House Bill 1602. This group is working "together on legislation and policy solutions on such matters as cryptocurrency regulation, the use of blockchain ledger technology, and the possible development of a U.S. Central Bank Digital Currency ([U.S. Committee on Financial Services 2021](#))". The SEC has argued that some digital coins are securities and therefore are subject to regulations ([PYMNTS 2021](#)).

11. Recent Tax Law Changes

The Infrastructure Investment and Jobs Act of 2021 contains three pages of tax provisions impacting digital assets. IRC Section 60501 now defines "digital assets" as cash, so businesses receiving more than USD 10,000 of digital assets must file a Form 8300 with the I.R.S. The name, address, taxpayer's identification, and other information must be provided for both the payer and the beneficiary (often the recipient) of the transaction. Failure to comply with this new filing provision can result in civil penalties of up to USD 3 million each year, with higher penalties if failure is due to intentional disregard of the filing requirement. Further, the new laws amend the definition of "broker" to include cryptocurrency exchanges, peer-to-peer money transfer services, and financial institutions that service cryptocurrency transactions [see Section 80603(a)(3)]. These provisions become effective in 2024.⁴

12. Conclusions

The popularity of cryptocurrency is illustrated by such cases as Odell Beckman Jr. taking his salary from the Los Angeles Rams in Bitcoins and Elon Musk purchasing USD 1.5 billion of Bitcoins in the last quarter of 2020. Moreover, innovative strategies are being developed to decrease the waste of natural resources and reducing toxic emissions. Many companies are using flared gas as a new means of energy to fulfill the enormous demand for crypto mining. However, there are concerns that these practices may be causing more harm than good. That said, a Deloitte survey in 2021 indicates that virtual currencies will be a key part of the future monetary system, and banks should embrace their eventual digital future ([Deloitte 2021](#)).

Stakeholders and influential leaders are concerned about using the Earth's fossil fuels too rapidly and the global warming caused by flaring and venting natural gas. Companies, however, are developing technology and strategies to be further efficient and to complete environmentally friendly oil and gas drilling to reduce climate change impacts. Flaring mining systems should benefit local communities, both environmentally, with less greenhouse emissions, and financially. Further, cryptocurrency mining with vented gas reduces some of the risks in drilling for oil and gas.

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Notes

- ¹ (Mikhaylov 2021). This study also addresses the minor problems of fraud with virtual currency and the lack of accounting standards.
- ² For example, Bitmart was hacked, with losses estimated to be USD 196 million. (Thurman 2021).
- ³ Accounting Standards Board of Japan. 2018. The Standards under Japanese GAAP.
- ⁴ For an excellent discussion of the severe consequences of these new provisions, see (Dunn 2021).

References

- American Chemical Society. 2019. Estimating the Environmental Impact of Bitcoin Mining. *Science Daily*. November 20. Available online: <https://www.sciencedaily.com/releases/2019/11/191120080246.htm> (accessed on 29 May 2022).
- Arora, Shivam. 2021. Bitcoin Mining Explained. *Simplilearn*. June 30. Available online: <https://www.simplilearn.com/bitcoin-mining-explained-article> (accessed on 29 May 2022).
- Ashford, Kate, and John Schmidt. 2022. What Is Cryptocurrency? *Forbes Advisor*. May 23. Available online: <https://www.forbes.com/advisor/investing/what-is-cryptocurrency/> (accessed on 29 May 2022).
- Association of International Certified Professional Accountants. 2022. Accounting for and Auditing of Digital Assets. Available online: <https://www.aicpa.org/content/dam/aicpa/interestareas/informationtechnology/downloadabledocuments/accounting-for-and-auditing-of-digital-assets.pdf> (accessed on 29 May 2022).
- Baker, Andrew. 2021. Bitcoin Mining Digging For E&P's Natural Gas Gold in Lower 48. *Natural Gas Intelligence*. June 25. Available online: <https://www.naturalgasintel.com/bitcoin-mining-diggingfor-eps-natural-gas-gold-in-lower-48/> (accessed on 29 May 2022).
- Bambrough, Billy. 2021. Forget Bitcoins—Putting Stimulus Checks into Dogecoin Would Have Made over \$500,000 Amid Crypto Price Mania. *Forbes*. May 7. Available online: <https://www.forbes.com/sites/billybambrough/2021/05/07/forget-bitcoin-puttingstimulus-checks-into-dogecoin-would-have-made-over-500000-amid-crypto-pricemaniam/?sh=735e79f13db4> (accessed on 29 May 2022).
- Borunda, Alejandra. 2019. Methane, Explained. *National Geographic*. January 23. Available online: <https://www.nationalgeographic.com/environment/article/methane> (accessed on 29 May 2022).
- Boucher, Jamie L., Eytan J. Fisch, Stuart D. Levi, Bao Nguyen, Khalil N. Maalouf, and James E. Perry. 2022. The Federal Reserve Weighs Risk and Benefits of a U.S. Central Bank Digital Currency. February 4. Available online: <https://www.skadden.com/insights/publications/2022/02/the-federal-reserve-weighs-risks> (accessed on 29 May 2022).
- Brooks, Miles. 2022. The Ultimate Crypto Tax Guide. Available online: <https://coinledger.io/blog/the-traders-guide-to-cryptocurrency-taxes> (accessed on 29 May 2022).
- Carroll, Alex. 2021. The Impact of Bitcoin Mining on Data Centers. *Lifeline Data Centers*. February 4. Available online: <https://lifelinedatacenters.com/data-center/impact-bitcoin-mining-datacenters/> (accessed on 29 May 2022).
- Cimpanu, Catalin. 2020. Browser-Based Cryptojacking Sees Sudden Spike in Activity in Q2 2020. *ZD Net*. August 25. Available online: <https://www.zdnet.com/article/browser-based-cryptojackingsees-sudden-spike-in-activity-in-q2-2020/> (accessed on 29 May 2022).
- Crypto Climate Accord. n.d. Make Cryptos Green. Available online: <https://cryptoclimate.org/solutions/> (accessed on 29 May 2022).
- Cryptocurrency Containers—What Is Bitcoin Mining? 2021. June GlenFarrow Electrical Services. Available online: <https://glenfarrow.co.uk/cryptocurrency-containers-what-is-bitcoin-mining/> (accessed on 29 May 2022).
- Cryptojacking Scams are on the Rise Once Again. 2021. After Declining for Two Years. *Business Insider India*. June 8. Available online: <https://www.businessinsider.in/cryptocurrency/news/cryptojacking-scams-are-on-the-rise-once-again-after-declining-for-two-years/articleshow/83335965.cms> (accessed on 29 May 2022).
- Davis, Carolyn. 2021. Ecoark Looking to Power Cryptocurrency Mining with Constrained Natural Gas. *Natural Gas Intel*. April 13. Available online: <https://www.naturalgasintel.com/ecoark-lookingto-power-cryptocurrency-mining-with-constrained-natural-gas/> (accessed on 29 May 2022).
- Deloitte. 2021. Global Blockchain Survey: Global Financial Services Industry Undergoing Seismic Shift; Banks Must Embrace Inevitable Digital Future. Available online: <https://www2.deloitte.com/us/en/pages/about-deloitte/articles/press-releases/deloitte-2021-global-blockchain-survey-global-financial-services-industry-undergoing-seismic-shift-banks-must-embrace-inevitable-digital-future.html> (accessed on 29 May 2022).
- Dunn, Gibson. 2021. Infrastructure Bill's New Reporting Requirements May Have Sweeping Implications for Cryptocurrency Ecosystem. November 18. Available online: <https://www.gibsondunn.com/infrastructure-bills-new-reporting-requirements-may-have-sweeping-implications-for-cryptocurrency-ecosystem/> (accessed on 29 May 2022).

- Eilperin, Juliet. 2021. St. Croix Refinery Halts Operations after Raining Oil on Local Residents Once again. *The Washington Post*. May 13. Available online: <https://www.washingtonpost.com/climateenvironment/2021/05/12/limetree-bay-refinery/> (accessed on 29 May 2022).
- EY. 2019. IFRS Developments: Holdings of Cryptocurrencies, Issue 150. August. Available online: https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/ifrs/ey-devel150-cryptocurrency-holdings-august-2019.pdf (accessed on 29 May 2022).
- Freedman, Robert. 2021. Cryptocurrencies Not on FASB's Agenda beyond Info-Gathering, CFO Dive. November 10. Available online: <https://www.cfodive.com/news/cryptocurrencies-not-on-fasbs-agenda-beyond-info-gathering/609845/> (accessed on 29 May 2022).
- Gans, Nicholas. 2021. Bitcoin Faces the Largest Ever Negative Difficulty Adjustment. *Forbes*. July 2. Available online: <https://www.forbes.com/sites/nicholasgans/2021/07/02/bitcoin-faces-the-largest-ever-negative-difficulty-adjustment/?sh=399683526cfc> (accessed on 29 May 2022).
- Gerasyimovych, Sergii. 2021. How Bitcoin Mining on Natural Gas Works. *EZ Blockchain*. Available online: <https://ezblockchain.net/article/how-mining-on-natural-gas-works/> (accessed on 29 May 2022).
- Gonzalez, Oscar. 2021a. Here's How Much Energy It Really Takes to Mine Bitcoin and Why People Are Concerned. August 31. Available online: <https://www.cnet.com/personalfinance/heres-how-muchenergy-it-really-takes-to-mine-bitcoin-and-why-people-are-concerned> (accessed on 29 May 2022).
- Gonzalez, Oscar. 2021b. Cryptocurrency Pump-and-Dump Schemes: Everything You Should Know. *CNet Personal Finance*. August 7. Available online: <https://www.cnet.com/personalfinance/cryptocurrency-pump-and-dump-schemes-everything-you-should-know/> (accessed on 29 May 2022).
- Hamilton, Ernest. 2021. Main Pros and Cons of Cryptocurrency Mining. *University Herald*. June 11. Available online: <https://www.universityherald.com/articles/77648/20210611/main-pros-and-cons-of-cryptocurrency-mining.htm> (accessed on 29 May 2022).
- Helms, Kevin. 2022. 105 Countries Are Exploring Central Bank Digital Currencies, CBDC Tracker Shows, Bitcoin.com. June 6. Available online: <https://news.bitcoin.com/105-countries-are-exploring-central-bank-digital-currencies-cbdc-tracker-shows/> (accessed on 29 May 2022).
- Kearney, Laila. 2021. A New Oil-Cryptocurrency Alliance Takes Shape in North America. *Financial Post*. May 21. Available online: <https://financialpost.com/commodities/energy/oil-gas/oil-drillersand-bitcoin-miners-bond-over-natural-gas-2> (accessed on 29 May 2022).
- Kiger, Patrick J. 2021. Cryptocurrency Has a Huge Negative Impact on Climate Change. *How Stuff Works*. May 17. Available online: <https://science.howstuffworks.com/environmental/conservation/issues/cryptocurrencyclimate-change-news.htm> (accessed on 29 May 2022).
- Kramina, Elena I. 2021. China on the Way to Achieving Carbon Neutrality. *Financial Journal* 13: 51–61. [CrossRef]
- Ling, Sam. 2021. How Much Does It Cost to Mine a Bitcoin? *Miner Daily*. May 4. Available online: <https://minerdaily.com/2021/how-much-does-it-cost-to-mine-a-bitcoin-update-may2021/> (accessed on 29 May 2022).
- Maloney, Peter. 2020. Bitcoin Mining Helps Boost a Growing Data Center Market. *Engineering New-Record*. November 18. Available online: <https://www.enr.com/articles/50762-bitcoin-mininghelps-boost-a-growing-data-center-market> (accessed on 29 May 2022).
- Maurer, Mark. 2021. Companies Want FASB to Focus on Crypto, ESG-Related Rule Making. *Wall Street Journal*. Available online: <https://www.wsj.com/articles/companies-want-fasb-to-focus-on-crypto-esg-related-rule-making-11633347900> (accessed on 29 May 2022).
- McDonnell, Tim. 2021. The Pandemic is Turning Fracking Companies into Bitcoin Miners. *Quartz*. March 29. Available online: <https://qz.com/1988503/bitcoin-miners-and-fracking-companies-areworking-together/> (accessed on 29 May 2022).
- Mikhaylov, Alexey Y. 2021. Development of Friedrich von Hayek's theory of private money and economic implications for digital currencies. *Terra Economicus* 19: 53–62. [CrossRef]
- Morgenson, Gretchen. 2021. Some Locals Say a Bitcoin Mining Operation is Ruining One of the Finger Lakes. Here's How. *NBC News*. July 5. Available online: <https://www.nbcnews.com/science/environment/some-locals-say-bitcoin-miningoperation-ruining-one-finger-lakes-n1272938> (accessed on 29 May 2022).
- Myers, Brad. 2022. This Is Why We Need Bitcoins. *Fox Business*. February 13. Available online: <https://www.foxbusiness.com/financials/why-we-need-bitcoin-brad-myers> (accessed on 29 May 2022).
- Nadeau, Michael. 2021. Cryptojacking Explained: How to Prevent, Detect, and Recover from It. *CSO Online United States*. May 6. Available online: <https://www.csoonline.com/article/3253572/what-is-cryptojacking-how-to-preventdetect-and-recover-from-it.html> (accessed on 29 May 2022).
- Oilman. 2020. How (and Why) Natural Gas Flaring Is Being Used to Mine Bitcoin. *Oilman Magazine*. December 15. Available online: <https://oilmanmagazine.com/how-and-why-natural-gasflaring-is-being-used-to-mine-bitcoin/> (accessed on 29 May 2022).
- Osborne, Charlie. 2019. Fish Ponds Disguised Theft of Oil Field Power in Cryptocurrency Mining Scheme. *ZD Net*. June 13. Available online: <https://www.zdnet.com/article/fish-ponds-providecover-for-stealing-oil-rig-power-in-cryptocurrency-mining-scheme/> (accessed on 29 May 2022).
- Peterson, T. F. 2021. To the Moon: A History of Bitcoin Price Manipulation. *Journal of Forensic & Investigative Accounting* 13. Available online: <https://www.nacva.com/jfia-current#1> (accessed on 29 May 2022).
- Pound, Jesse. 2021. The Crypto Collapse: Here's What's Behind Bitcoin's Sudden Drop. *CNBC*. May 19. Available online: <https://www.cNBC.com/2021/05/19/the-crypto-collapse-heres-whats-behindbitcoins-sudden-drop.html> (accessed on 29 May 2022).

- PYMNTS. 2021. U.S. House Passes Bill to form 'Digital Asset Working Group'. April 21. Available online: <https://www.pymnts.com/cryptocurrency/2021/us-house-passes-bill-to-form-digital-assetworkinggroup/> (accessed on 29 May 2022).
- Robertson, Harry. 2021. Meet the Company Mining Bitcoin Using the Flare Gas from Oil Drilling and Drawing Investment from Coinbase and the Winklevii. *Market Business Insider*. June 20. Available online: <https://markets.businessinsider.com/currencies/news/bitcoin-mining-flare-gas-btcenergy-crusoe-energy-coinbase-winklevoss-2021-6> (accessed on 29 May 2022).
- Seeking Alpha. 2021. Bitcoin: This Will Be the Worst 'Crypto Winter'. *Seeking Alpha*. May 24. Available online: <https://seekingalpha.com/article/4430832-bitcoin-this-will-be-the-worst-cryptowinter> (accessed on 29 May 2022).
- Sigalos, MacKenzie. 2021. How the U.S. Became the World's New Bitcoin Mining Hub. *CNBC*. July 17. Available online: <https://www.cnbc.com/2021/07/17/bitcoin-miners-moving-to-us-carbonfootprint.html> (accessed on 29 May 2022).
- Tassev, Lubomir. 2019. Bitcoin Mining Helps Oil Companies Reduce Carbon Footprint. *Bitcoin*. July 19. Available online: <https://news.bitcoin.com/bitcoin-helps-oil-companies-reduce-carbonfootprint/> (accessed on 29 May 2022).
- Thurman, Andrew. 2021. Crypto Exchange Bitmart Hacked with Losses Estimated at \$196M. *CoinDesk*. December 4. Available online: https://finance.yahoo.com/news/crypto-exchange-bitmart-hacked-losses-025521149.html?fr=sycsrp_catchall (accessed on 29 May 2022).
- United States Securities and Exchange Commission. 2014. SEC Announces Charges in Houston Based Scheme Touting Technology to End Fracking. In *SEC*; August 15. Available online: <https://www.sec.gov/news/press-release/2014-168> (accessed on 29 May 2022).
- U.S. Committee on Financial Services. 2021. Waters Announces Digital Assets Working Group. June 16. Available online: <https://financialservices.house.gov/news/documentsingle.aspx?DocumentID=408014> (accessed on 29 May 2022).
- Yakovlev, Igor A., Lyudmila S. Kabir, and Svetlana I. Nikulina. 2021. *Changes in Climate Policies and Financial Strategies of Their Implication in the EU and Russia*. Moscow: Financial Research Institute, pp. 11–28.