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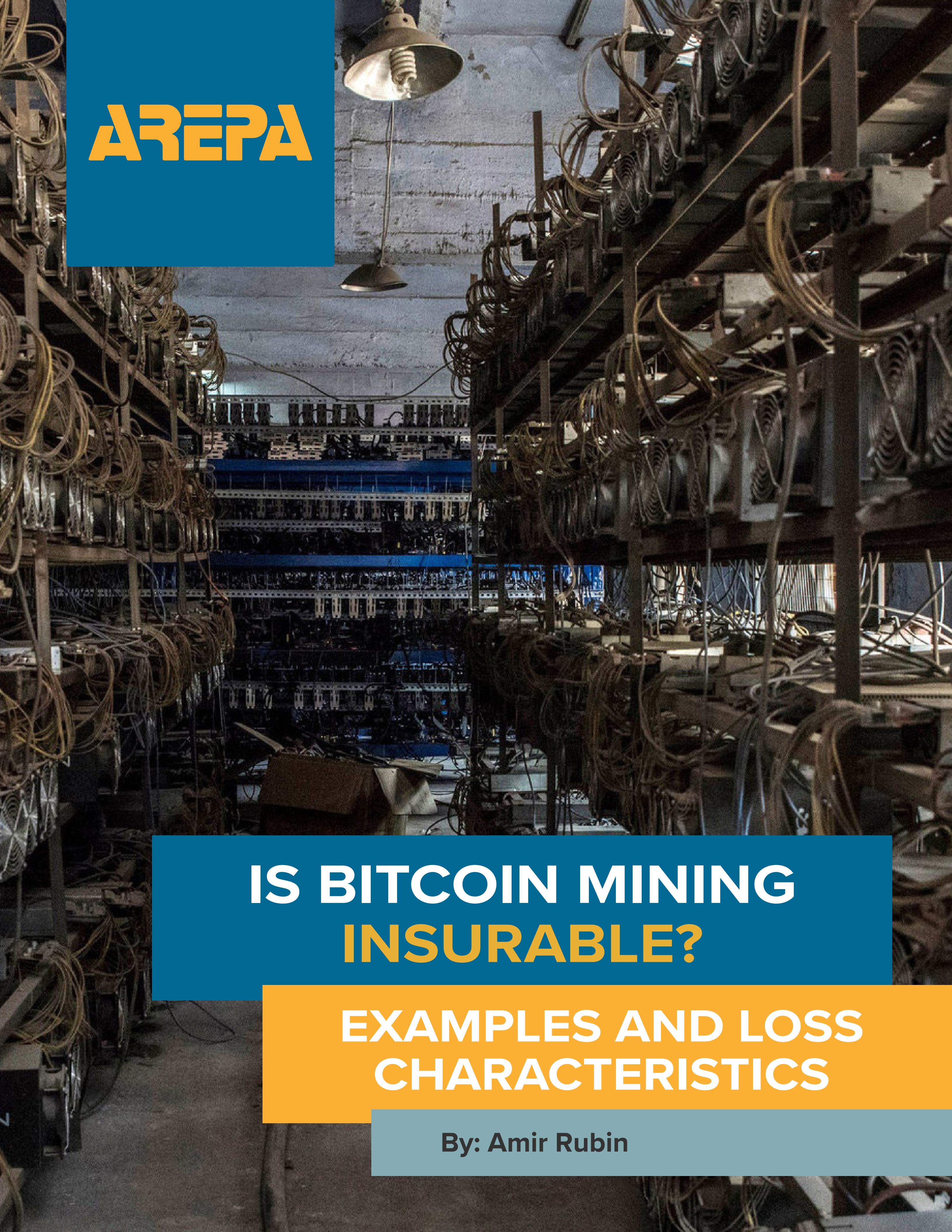

IS BITCOIN MINING INSURABLE?

EXAMPLES AND LOSS CHARACTERISTICS

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INSURANCE CONSIDERATIONS FOR BITCOIN MINING EQUIPMENT

Since the introduction of Bitcoin in 2009 and cryptocurrencies in general, the use of digital currencies has continued to grow. Early adopters utilized personal computers to complete the necessary steps that would result in new digital "coins". Commercial deployment of specialized mining servers, and introduction of mining farms, followed shortly after.

The Y2K crisis in the late 1990s was likely the insurance industry's first large scale introduction to the risks of insuring technology. The insurance industry normally relies on historical actuarial data that details frequency and severity of loss. The rapidly changing nature of crypto mining technology makes actuarial data unreliable. Therefore, while Bitcoin and other crypto currencies have been mined for over 10 years, a large portion of the insurance industry is still not comfortable underwriting this type of risk.

Old Mutual, a Cape Town based insurance carrier, released a statement that it is opting out of insuring crypto mining equipment due to the absence of regulation and the industry's fondness of using a modified electronic infrastructure that operates 24/7, making it highly prone to overheating and other malfunctions. Old Mutual went on to say that even doing a comprehensive inventory of the insured equipment is difficult, because the value of the highly modified computer equipment is typically inflated and almost impossible to verify as it is usually imported from obscure suppliers in the Far East.

The words "crypto mining equipment general liability coverage" or "Bitcoin mining equipment insurance" yield few search results, indicating that there is no widespread specialized coverage for crypto or Bitcoin equipment. However, crypto mining equipment would readily fall under the description or definition of computer hardware or datacenter server equipment, terms that insurance carriers have experience with. This paper will attempt to provide color on underwriting and post loss considerations for an industry that is growing far quicker than most expected. In an effort to paint a complete picture, let's provide some background first.

WHAT IS CRYPTOCURRENCY / EXPECTED APPLICATIONS

Endorsements by high profile tech entrepreneurs, sports figures and investment banks, have made cryptocurrency, and more specifically Bitcoin, a household name. Cryptocurrencies are digital/virtual currencies that use a cryptographic approach to regulate the generation of currency and verify the transfer of funds. Derived from the Greek word Kryptos, i.e. hidden, cryptography is a method of protecting information through the use of codes. Unlike the US dollar, or other government backed and regulated money, Bitcoin is decentralized (no central authority is in control), and trusted third parties do not verify transactions. Instead, the currencies rely on blockchain technology, a secure public ledger that is programmed to record all of the transactions. This method of public recording prevents people from making copies, undoing transactions, or spending coins they do not own. While there are more than 4000 cryptocurrencies in existence, we will focus on Bitcoin simply because of name recognition.

- **Cryptocurrency** is a peer-to-peer (P2P) value transfer system that has the potential to revolutionize the way we transact, store, and account for funds that only exist virtually.
- **Blockchain** - Bitcoin's ledger or database that stores all transaction data. Blockchains store data in blocks that are then chained together. As new data comes in, it is entered into a block. Once the block is filled, it is chained to the previous block, which makes the data chained together in chronological order.

- **Bitcoin wallet** - A software application that enables a person to view their Bitcoin holdings as well as send or receive Bitcoins.
- **Public & private keys** - The idea behind public and private keys is to ensure that transactions are executed by the owners of the funds. A private key unlocks the owners' ability to spend their Bitcoins and should not be shared with others. Private keys are basically the users' password, although it is a long system generated password that consist of letters and numbers. The public key is used to ensure you are the owner of an address (similar to a bank account number) and enables Bitcoin to be received and locked. As the name suggests, public keys can be seen by others much like a username. Therefore, almost anyone can see your username but only you or trusted entities know your password. If the owner cannot recall their private key (password), they can no longer access their Bitcoin wallet to spend funds. Stefan Thomas, a programmer from San Francisco, may never gain access to his 7,002 Bitcoins because of a forgotten password.

According to Federal Reserve Chair Jerome Powell, cryptocurrencies are "highly volatile and therefore not really useful stores of value and they're not backed by anything. It's more a speculative asset that's essentially a substitute for gold rather than the dollar". Regardless of how cryptocurrencies are utilized or will be utilized, hardware manufacturers are currently experiencing a surge in demand for mining servers that can efficiently verify transactions and mine new digital coins. This is because the value of Bitcoin is high enough to make investment in equipment worthwhile. If the value of Bitcoin drops, the demand for the equipment will also drop. This makes the equipment valuation highly volatile.

THE PROCESS OF MINING

Satoshi Nakamoto, assumed to be the original developer of Bitcoin, designed the system with a supply limit of 21 million coins, while the blockchain can continue to record an unlimited number of transactions. Bitcoin is housed on a network of computers, connected through the Internet, called nodes. The Bitcoin ecosystem is subject to a set of rules that apply equally to everyone. Since it is based on cryptography, these rules involve solving complex mathematical problems. The system is kept going by miners and nodes.

- **Bitcoin mining** - The process by which one or more computers (rigs) validate Bitcoin transactions. Mining efforts are rewarded in Bitcoin for performing the validation process. Mining also generates new units of cryptocurrency by solving complex mathematical problems.
- **Node** - A personal computer, laptop, or server computer connected to other computers that follow rules and share data. Nodes form the infrastructure of a blockchain. A full node hosts and continuously synchronizes a copy of the entire blockchain with other computers/nodes.
- **Hashing** - A process by which an input string of any length is converted into an output of a fixed length. From a cryptocurrency perspective, the transaction data is the input string, which goes through a hashing algorithm that produces the fixed length output. Bitcoin utilizes the Secure Hashing Algorithm 256 (SHA-256), which means that regardless of the input transaction data size, the output has a fixed length of 256-bits.

The cost of mining boils down to the cost of leasing a facility (when considering larger operations), the cost of equipment, and power consumption. The more computing power is employed to do the hashing, the bigger the share of the monetary reward. The surge in Bitcoin price and public interest in cryptocurrencies in general, has incentivized hardware manufacturers to build efficient computer servers that are designed specifically for mining. Because mining involves an understandable sense of urgency, equipment is expected to operate continuously at its functional limits.

WHERE IS MINING TAKING PLACE

When considering a computer data center, the infrastructure set up is fairly traditional. Large or small, the data center is a specialized, protected, climate controlled area within a building, that in many cases also incorporates filtration solutions to maintain the flow of clean air. Data centers are designed to optimize the reliability of the equipment housed within, and protect the data on those pieces of equipment. This is done at considerable expense and that expense is not always cost effective for crypto-mining operations.

Mining servers in a repurposed building and the electrical feed into that building. Published with permission from Gilles Sabrie.

Peter Haken, Property/Casualty Senior Consulting Underwriter at Gen Re, explains in an article titled: Bitcoin Mining Facilities - What Property Insurers Should know, that "Bitcoin mining facilities are not your traditional data processing centers. Crypto-mining facilities often have risk features that make them more hazardous than underwriters typically envision when they think about a data processing center. Since crypto-mining requires vast amounts of computer processing power and is therefore extremely energy intensive, It's not uncommon to repurpose a large factory, such as a retired metals smelter or other heavy manufacturer, into a crypto-mining operation because of its excellent connection to the power grid. This is an ingenious way to use a site that might have otherwise remained idle. It does, however, result in some non-traditional construction types and unusual building configurations that also lack the automatic fire suppression systems common in other data centers.

The desire for low cost real estate and energy results in miners staging equipment in buildings that are located in more remote areas, where land or buildings are less expensive to build, obtain, or lease, but adjacent to a power supply able to meet its requirements. The downside to remote locations is that they typically receive a delayed fire-fighting response."

Northern Bitcoin AG, a German technology company focused on the Bitcoin blockchain and based in Frankfurt, deployed over 3000 mining servers that are operated in shipping containers, all of which are housed in a defunct olivine mineral mine from the 70's. Situated northwest of Sandane, Norway, the Lefdal mine is powered by 100% renewable energy from four glacial hydropower stations and two wind farms.

A coal-fired power plant that began its operation in 1937, was converted to natural gas in 2017 and since 2020 is providing power and blockchain services. The power plant itself houses a "data center" with mining operations inside, as well as mining equipment staged next to the plant. The power plant's literature describes the facility as a cryptocurrency mining hybrid, or a blockchain mining facility with an in-house power plant that is permitted to utilize electricity behind the meter.

A power plant with mining equipment both inside the facility and next to it.
Published with permission from EZ Blockchain

Viru Keemia Grupp (VKG) www.vkg.ee, an Estonian industrial enterprise, produces electricity among other services. VKG houses crypto mining trailers on site for NordCoin Mining, a manufacturer of mobile mining containers and hosting services. NordCoin benefits from favorable electricity pricing. www.nordcoinmining.com. Pictures credit VKG and NordCoin.

ELECTRICITY CONSUMPTION

In April 2011, a Bitcoin was valued at $1 (USD). Ten years later, the value of Bitcoin skyrocketed to over $60,000 (USD) with heavy volatility. As interest increased in cryptocurrency and hundreds of thousands of servers were deployed to mine around the clock, energy consumption in this industry sector grew exponentially. It is interesting to point out that Satoshi Nakamoto was fully aware that more processing power, and therefore electricity, would be needed as the blockchain grew, because by design mining for new coins and verifying transactions became more complex over time.

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There are multiple factors that contribute to mining energy consumption:

1. Computing power
2. Hash rate
3. The difficulty of solving the complex mathematical problems
4. Thermal regulation for the hardware

The University of Cambridge publishes an electricity consumption index. The consumption rate estimation tool is updated every 30 seconds. The team at Cambridge note that Bitcoin mining globally currently consumes over 121 terawatt-hours (TWh) per year. For comparison purposes, The Netherlands consumes approximately 108 TWh, Argentina 121 TWh and Norway 122 TWh. The University showed that the amount of electricity used annually by the Bitcoin network, could satisfy the University's energy needs for approximately 700 years.

Due to the increased computing required to mine for new coins and perform the transaction verification process, the amount of energy used grew dramatically. Due to this increased energy use, some people are reconsidering digital currencies because of the negative effect on the environment. In fact, Elon Musk, CEO of Tesla Motors, announced that Tesla will no longer accept Bitcoin as payment for their cars due to the environmental impact of mining.

Jamie Redman authored an article on Bitcoin.com titled: Bitcoin Energy Consumption is Far More Efficient and Greener than Today's Banking System. Mr. Redman's research concluded that the global banking system electricity usage is well over 140 TWh per year. Factors that contributed to this figure included computer servers, physical branches and automated teller machines (ATMs). Recall that the team at Cambridge estimated that Bitcoin mining globally currently consumes over 121 TWh per year, and this figure is expected to rise.

In an effort to gain a full perspective, we need to remain cognizant that 100 million or so people are actively using cryptocurrency. The World Bank estimated in 2018 that 3.8 billion people held traditional bank accounts. While there is a disproportionate use of electricity for crypto mining purposes, a great deal of the energy utilized is produced in hydropower and geothermal plants as well as wind and solar farms.

Robert Thurston, a U.S. steam engine expert, opined in 1894, that horses are not only "self-feeding, self-controlling, self-maintaining and self-reproducing, but they are far more economical in the energy they are able to develop from a given weight of fuel material, than any other existing form of motor." Will we see a reduction in energy consumption by the banking system as cryptocurrencies continue to grow in popularity? Is cryptocurrency Henry Ford's faster horse?

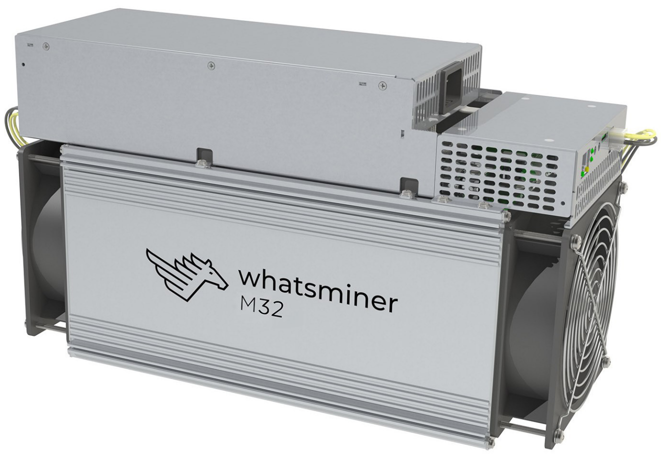
MINING EQUIPMENT, COST AND AVAILABILITY

The equipment utilized to mine cryptocurrency has evolved over time. Bitcoin could initially be mined cost effectively with a laptop or desktop computer. As interest in mining increased, miners discovered that video graphic cards could more efficiently process hashing algorithms. Field Programmable Gate Arrays (FPGAs) replaced graphic cards, as the circuits in an FPGA could be configured and programmed by users in the field.

Application Specific Integrated Circuits (ASICs) replaced the laptops, desktops, graphic cards and FPGAs. ASICs were designed for a particular use, such as Bitcoin mining, and they are now the dominant mining technology. As more sophisticated equipment was adopted, serious miners also moved away from working individually to working in larger groups. Many miners have determined that it is more cost efficient to join “mining pools” that help disperse the energy and equipment costs (and the profits) and increase the speed or likelihood of a successful transaction.

When miners research which ASIC servers to deploy, the following factors are considered:

- Hash rate - How many hashes per second, or calculations per second, can the equipment process? Equipment that can hash faster costs more, which is why efficiency is crucial.
- Efficiency - An efficient ASIC server will cost its user less in electricity per hash.
- Price



Whatsminer M32 - $8,550 - 66 trillion hashes (calculations) per second (TH/s). Published with permission from Jennifer Tillman at BlokForge.

Bitmain Antminer S19 Pro - $17,500 - 110 TH/s. Published with permission from Jennifer Tillman at BlokForge.

Manufacturers of ASIC mining servers have increased prices by over 100%, to capitalize on demand resulting from the surge in the price of Bitcoin. While older generation servers are available in used condition, new hardware lead times are up to five months.

CRYPTO FARM EXPECTED UPTIME AND EQUIPMENT LIFE EXPECTANCY

Similar to traditional data centers, equipment in crypto mining farms is utilized around the clock. The majority of enterprise level data center systems strive to achieve the “five nines” reliability goal, which means that equipment will operate properly 99.999% of the time. The achievement of this goal decreases unscheduled downtime to just a couple of minutes per year. Manufactures do not count scheduled downtime.

Table 1 - Levels of Availability			
Level of Availability	Percent of Uptime	Downtime per Year	Downtime per Day
1 Nine	90%	36.5 days	2.4 hrs.
2 Nines	99%	3.65 days	14 min.
3 Nines	99.9%	8.76 hrs.	86 sec.
4 Nines	99.99%	52.6 min.	8.6 sec.
5 Nines	99.999%	5.25 min.	.86 sec.
6 Nines	99.9999%	31.5 sec.	8.6 msec

Equipment availability and maximum unscheduled downtime

Crypto mining hardware manufactures design servers with maximum performance in mind for a given price point. Similar emphasis does not appear to be placed on meeting reliability, availability and serviceability. Samson Mow, Chief Strategy Officer at Blockstream, a provider of blockchain technologies, advised that crypto servers normally experience a 5% failure rate. Such a rate equates to 18.25 unscheduled downtime days as a result of a malfunction (1.5 nines). Mr. Mow provided this rate as some of the most popular mining servers were experiencing 20-30% failure rates.

The noted higher failure rates did not appear to be a wide spread industry problem, and that specific equipment manufacturer has since delivered a new generation of hardware that is performing similar to other popular brands. Even without clear industry reliability standards, and from a life expectancy perspective, the economic benefit a server provides diminishes faster than the typical 5 - 7 year life expectancy for enterprise computer equipment. The math behind this assumes that a retail utility consumer will pay more at some point for electricity than the value of the awarded and mined Bitcoins. The ability to secure cheap electricity is key, in addition to a fairly large number of servers with high hash rates.

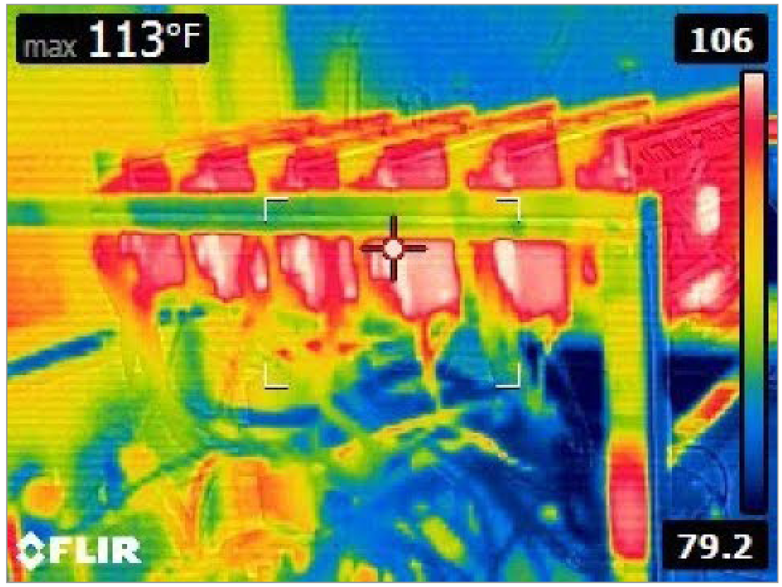
FACTORS THAT CONTRIBUTE TO HARDWARE FAILURES

Similar to other connected electronic devices, crypto mining servers experience software related issues, improper set up challenges, network connectivity difficulties and other problems that are easily solvable.

Unlike traditional data centers (enterprise, managed services, colocation and cloud) with proper environmental controls, crypto mining hardware is placed in unique locations with cost of electricity and equipment cooling needs as the primary drivers. Dust, temperature fluctuations, elevated humidity and even salinity (dissolved salt in a body of water and a strong driver of conductivity) are rarely controlled in these types of environments. The lack of controls contributes to failures related to improper heat dissipation and electrical bridging.

- Heat dissipation - A type of heat transfer that occurs when an electronic assembly that is generating heat, is placed in an environment where the heat is transferred to colder assemblies (heat sinks) and/or the surrounding environment. Heat can adversely affect crypto mining hardware and may impair safety, performance, and reliability. Excessive heat caused by poor dissipation will degrade performance in the form of slowing operating speed, damage circuit board assemblies and could result in a fire. Reliability is affected through device malfunctions and a shorter system life.

  The picture displays a thermally imaged mining rig with six graphics processing units. The blue shaded areas are cold versus the yellow and red that exhibit temperatures of up to 113°F.



Thermal imaging of six graphic processing units. Picture credit The Bitcoin Miner.

- Electrical bridging - Refers to a condition in which electricity strays outside the established pathway of an electrical circuit. Bridging can result in hardware damage, electrical shock, or even a fire.
- Power surge - When a power surge occurs, it searches for the easiest path to the ground. Unfortunately, in many cases, this path is directly through sensitive electrical and electronic components, not designed to protect themselves from the high currents present in a power surge. This over voltage condition is only momentary, but can cause severe damage to the components in the ground path, and manifests itself in the form of overheating, breakdown, or cause the equipment to catch fire.
- Power quality - Electric power quality is the interaction of power with electrical equipment. If the supplied voltage and current is within a set of parameters, we would say that the electrical power is of good quality. If the voltage, current, or both are outside of those parameters, we would suspect that the power quality is poor. The majority of power quality problems are related to issues within a facility as opposed to the utility. Typical problems include grounding and bonding problems, wiring issues, code violations and internally generated power disturbances.

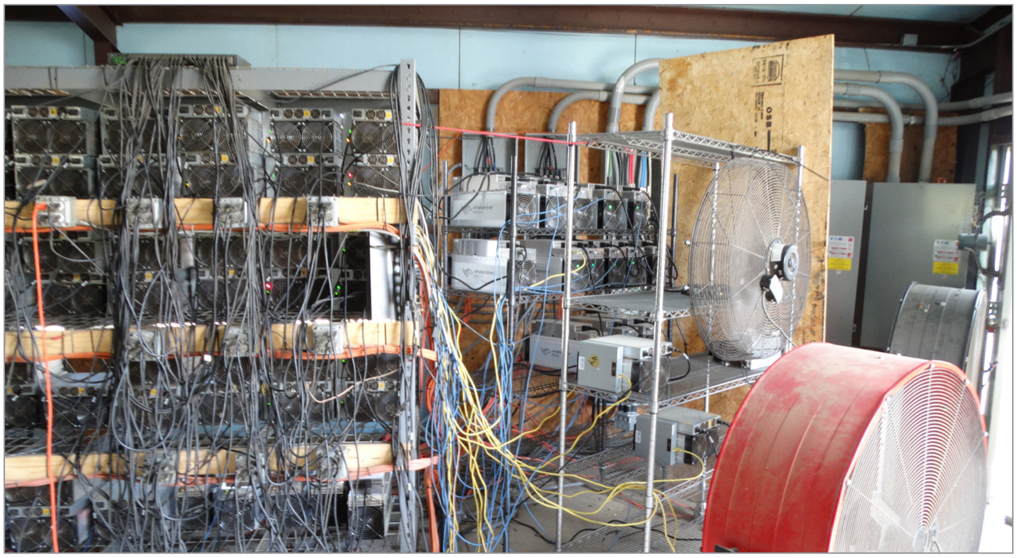
EXAMPLES OF LOSSES

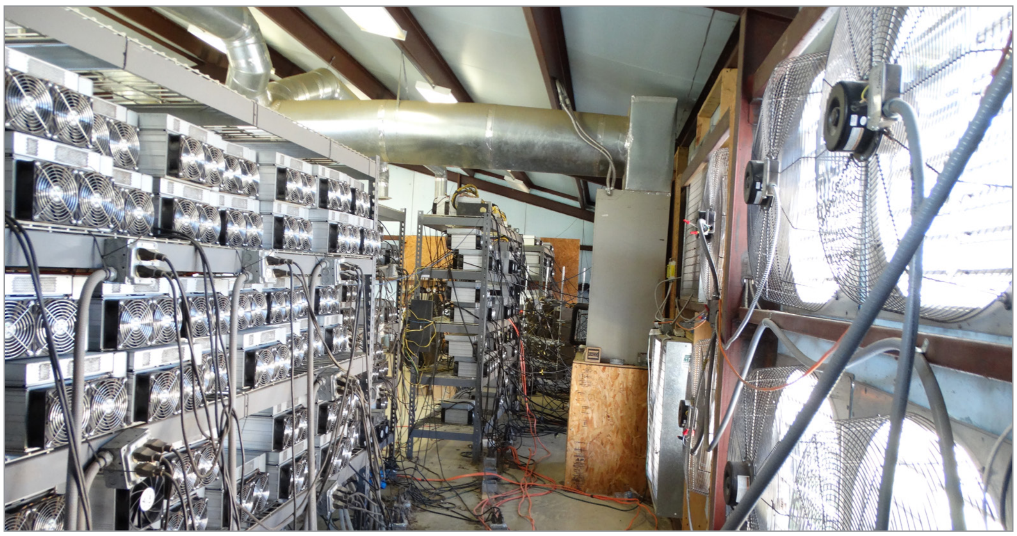
1. The Great Texas Freeze

The equipment owner operates two nearby locations that house over 100 Bitcoin servers. During the Texas freeze event, the utility increased the cost of energy from $0.04 per kilowatt hour (kWh) to $3.50 kWh (8650% increase). As a result of this dramatic price hike, the owner decided to power off all the equipment as mining at such a rate was not cost effective.

Both locations feature intake fans to draw in outside air, as well as exhaust fans for the heat generated. Neither location is environmentally controlled. Since they cannot be heated or cooled, there is no way to control ambient humidity. Of note is that one of the two locations does have proper ducting overhead for heating and cooling.

However, the ducting has never been utilized as it is not connected to a heating, ventilation and air conditioning (HVAC) system.





First location mining hardware on the metal shelving and exhaust fans on the right. Picture credit Envista Forensics.

Once energy rates normalized back to pre-event levels (approximately a week later), the equipment was powered on. The owner noticed that almost 50% of the servers exhibited some type of problem. Slower hash rates, servers that would not power on as a result of failed power supplies, circuitry with only a few working ASIC processing chips, as well as fan failures. The owner advised that they only clean the equipment if the servers are experiencing an over temperature event.

Evaluation of the equipment circuitry in both locations revealed the presence of pollen, dust and debris consistent with operation in an uncontrolled environment open to unfiltered air. Researched environmental conditions showed temperatures that fluctuated between freezing and 40°F (~4°C). Relative humidity was between 70% and 100%. A detailed evaluation of the circuitry revealed pollen and dust that were matted to electronic components.

In a dry environment dust simply settles on a surface. When condensation is involved, the same debris could also adhere to the surface. In this scenario, the debris not only acted as an insulator, but also caused electrical bridging to occur as conductive contaminants bridged electronic components. The conclusion was that the cold temperatures during the freeze event were not the reason for the noted failures. The decision to power off contaminated equipment, that is housed in environmentally uncontrolled facilities, allowed condensation to form and matt those conductive contaminants to circuits that sustained electrical damage as a result.

2. Environmental Impact

The below images were published by a Reddit member. Context was not provided. The comments that followed pointed to confusion regarding how these scenarios could have happened. From an insurance claims perspective, the losses are straight forward. Regardless of how snow got into the structures, it covered the equipment, and as it melts, sensitive electronic assemblies will be exposed to water. The likelihood of the equipment owner disassembling everything, drying the equipment, removing introduced contaminants via decontamination, and reassembling everything, is very low.

Equipment exposed to harsh elements. Pictures credit Reddit member EasyRider1975.

Picture 1 - A shipping container retrofitted for mining applications. Based on the snow accumulation, it could be argued that the equipment was not powered on during the event, and snow was introduced from the same direction as the person who took the picture, or from right to left. Did the container lose power and a door was inadvertently left open?

Picture 2 - A structure that is housing equipment although not originally designed for this sort of application either. Irrespective of how the snow was introduced, which appears to be from the left opening, the insurance claim is the same as in Picture 1.

When considering a data center building, were heat, ventilation and air conditioning are designed to control the environment, a fire suppression system is installed and everything meets code, short of a roof collapse or other structural compromise, the losses observed in pictures 1 & 2 simply do not occur. Neither structure appears to have sustained physical damage. In its current state, the equipment is not damaged. The mining servers may eventually sustain damage in the form of corrosion and rust, if decontamination activities are not employed before the equipment is powered on for testing.

3. Undersized Extension Cords

A fire originated in a second floor office building suite. It was suspected that the occupants' computers were the cause. Heat damage was confined to that suite, although smoke exposure was noted in surrounding suites. A four-foot diameter hole had to be cut into the ceiling as part of the firefighting efforts.

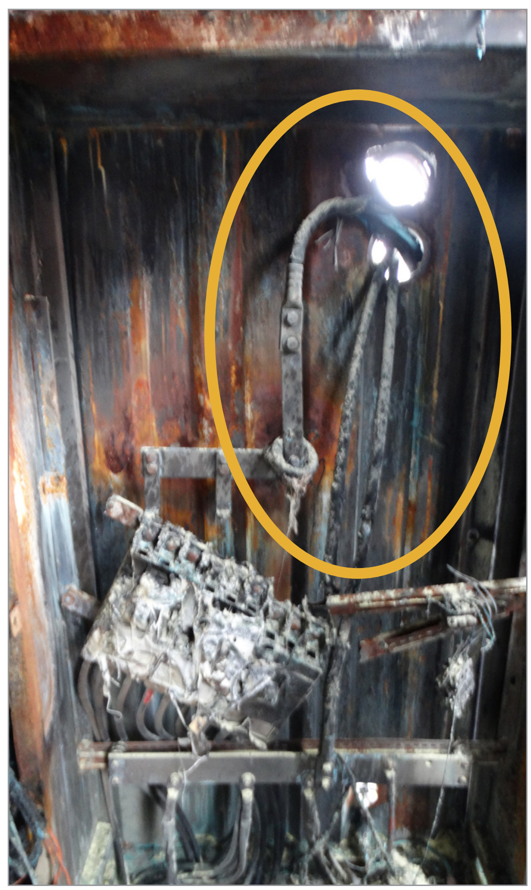
The occupant is an insurance agent that was interested in Bitcoin mining. The occupant monitored his equipment's functionality through a cellular telephone application, and received updates if anything abnormal was happening. The occupant received an alert that a Bitcoin server was overheating and as a result shutting down. Approximately 10 minutes later, he received notice from the alarm company that there was a fire in his suite.

Based on evidence that was collected at the scene, undersized extension cords and power strips appear to have been utilized to power the Bitcoin servers. An extension cord is a bundle of insulated electrical wires with a plug on each end. Electrical current flowing through wires generates heat, and when too much current flows through a wire, it can overheat and melt the plastic insulation causing a short circuit and a fire. Almost all extension cords have a plug that will be used in a 15-Amp or 20-Amp receptacle. However, not all extension cords are rated for a 15-Amp or 20-Amp draw. When an extension cord is used to power a power strip, the current draw can easily exceed the rating of the cord. As noted, when the current drawn exceeds the rated amperage capacity, the cord will overheat and can cause a fire. Because the bitcoin mining operators are attempting to save costs in all areas, it would not be uncommon for an operator to save money by purchasing and using the less expensive cords that are not rated for the current draw that they will be expecting the equipment to use.

4. Improper Installation

Fire in one of two shipping containers that house Bitcoin mining servers. The containers are stored outdoors in front of large transformers that energize the servers inside. The fire consumed the majority of the container contents. The origin appeared to be the power distribution panel within the container (circled in yellow on the right). A closer look at the 480V cable that enters the panel revealed chafing. Chafing is damage to the insulation and shielding of a wire. This is typically caused by wires rubbing against each other or a rough surface.

The cable was inserted through a hole on the back of the container. A protection sleeve was not installed in neither one of the observed holes. The wiring insulation was touching the bare steel. The claimed electrical arc explosion and resulting fire were likely a result of a combination of inadequate protection around the hole in the cabinet, and large side mounted fans causing the container to vibrate such that over time the cable insulation chafed, which eventually exposed the electrical wiring. The wiring came in contact with the container, which is grounded, and caused a short circuit. This is an example of improper installation that would not meet code in a regular structure.



The electrical cable chaffed wiring insulation in contact with the container. Picture credit Envista Forensics.

Pad mounted transformers in front of the shipping containers.
Picture credit Envista Forensics.

The power distribution panel in the affected container.
Picture credit Envista Forensics.

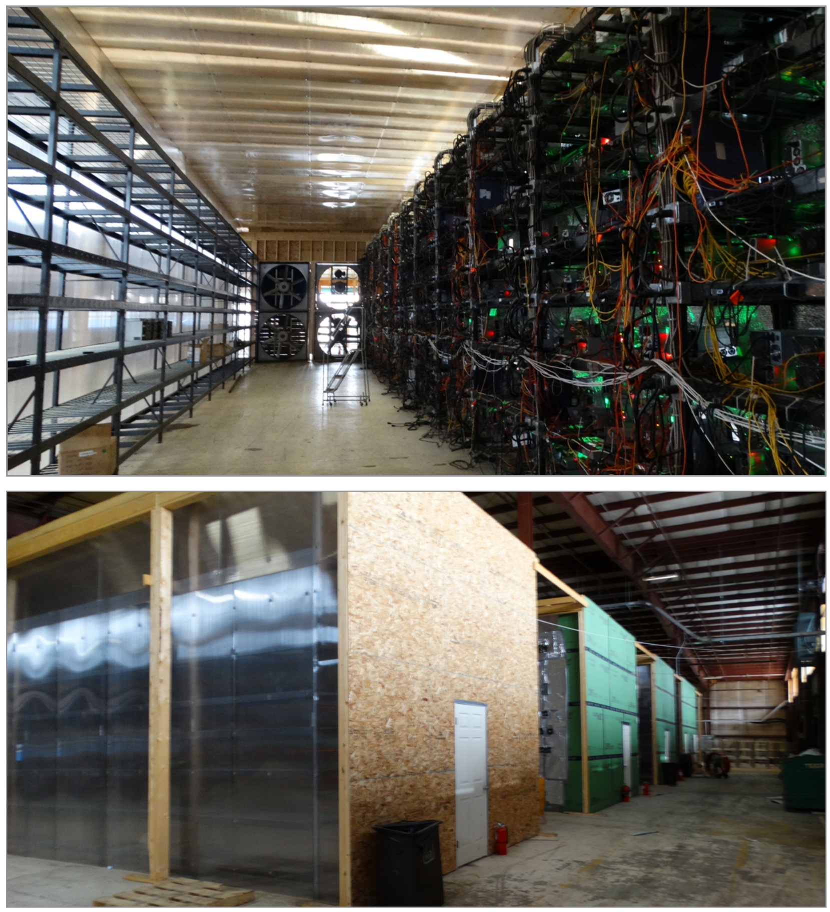
POST-LOSS CONSIDERATIONS

The loss examples above can be summarized as follows:

1. The great Texas freeze - Bitcoin mining servers that require decontamination to remove the matted debris off the electronic circuitry. Thereafter, testing and repair to restore full functionality.
2. Environmental impact - Equipment that requires decontamination before it can be powered on for testing.
3. Undersized extension cords - Some of the Bitcoin servers sustained heat damage and require replacement, while others exhibit smoke exposure and can be restored.
4. Improper installation - Bitcoin servers were consumed and require replacement. The servers in the container that did not exhibit heat damage should be decontaminated.

While replacement with like, kind and quality (LKQ) is typically straight forward, the current volatility and non-standard supply chain make valuation very difficult. Recovery of hardware that simply exhibits contamination is not as clearly understood. The picture to the right was captured in the same site that exhibited improper installation (example 4). While the shipping containers, one of which caught fire, were staged outdoors, the large warehouse next to those containers housed hundreds of Bitcoin mining servers.

The image to the right exhibits debris normally seen in a construction site. Fortunately for the owners, the observed debris was not part of the loss. The container outside was the subject of this loss. The large fans mounted on the side of the building were drawing air out towards the containers. Had this been configured the other way around, all the smoke from the consumed container would have entered the warehouse as well as all the Bitcoin servers.



Warehouse housing hundreds of Bitcoin mining servers.
Pictures credit Envista Forensics.

In similar cases smoke was introduced into the warehouse and penetrated the Bitcoin servers that were in operation. Physically the hardware was unharmed, although corrosive contaminants settled on sensitive electronic circuitry. Along with construction / environmental debris, corrosive and conductive contaminants cause circuitry to overheat and bridge between electronic components. This scenario happens daily in data centers and office buildings that house computer equipment. A fire erupts, materials in and around that limited area are consumed, and equipment in other parts of the facility are coated with soot and claimed as damaged.

Equipment further away exhibits a layer of fire related contaminants that settle on top of pre-existing debris. While environmental debris is normally removed when preventive maintenance is performed, many equipment owners elect not to power down equipment that is utilized around the clock. Following a fire, unexpected equipment failures, which directly translate to business income loss, present an unacceptable risk. Bitcoin mining servers currently have a five-month lead time and demand is not expected to slow as Bitcoin's value increases. Therefore, replacement may not be the best option.

Professional decontamination is a sought-after option. It restores the Bitcoin servers to the same cleanliness levels they met when first manufactured, and allows owners to resume production with minimal downtime. The post decontamination cleanliness is almost always better than what existed in those servers just before the loss. It is important to note that professional decontamination is not the same as preventive maintenance cleaning.

- **Preventive maintenance cleaning** - Performed while equipment is fully operational and involves minimal disassembly. The goal is to keep optimal equipment performance by cleaning, lubricating, and even replacing components that may cause unexpected failures as the equipment keeps operating.
- **Professional decontamination** - Performed following a disaster and involves comprehensive disassembly. The decontamination process has to ensure that all contaminants, loss related and environmental, are removed. Following the decontamination, equipment undergoes thorough testing, repair and recalibration. The equipment has to meet published industry cleanliness standards and original equipment manufacturer (OEM) operating parameters.

SUMMARY

The advent of cryptocurrencies ushered in the modern day thrill of a digital gold rush. While gold nuggets were physically mined in the Sacramento Valley, cryptocurrencies can be mined from anywhere electronically. Blockchain technology keeps the system free of fraudulent activity through user involvement. Users who store the public blockchain ledger and continuously update it, are compensated with new coins.

By design, the inventor of Bitcoin made it harder and harder to mine new coins as circulation increased. Solving complex mathematic problems and updating the blockchain, now requires a great deal of computing power, hence the global increase in electricity consumption in an industry that surpassed $1T (Trillion) in value.

The hardware infrastructure behind the cryptocurrency network is not regulated. Some equipment owners stage mining servers in proper installations, such as datacenters that meet building and electrical code, while others opt to save on the cost of infrastructure in an effort to deploy more capital on mining hardware. Many insurance companies view lax risk management practices as a reason to resist coverage. However, if a site survey is performed, allowing the insurance underwriter to properly assess risk and recommend a policy premium based on observed loss prevention practices, and in consideration of post loss restoration techniques that have been employed successful for decades in far more sensitive industries (medical, food processing, and military), the overall risk of underwriting a crypto farm can be successfully managed.

No different than other losses involving time sensitive equipment, replacement hardware with a five-month lead time presents a challenging solution when business income loss is measured in minutes. Every 10 minutes, around the clock, a new Bitcoin block is added to the blockchain. While the hardware infrastructure is not regulated, there are industry standards for the electronic circuitry within the Bitcoin servers. Restoring equipment back to those industry standards is the foundation of a successful recovery. Meeting published cleanliness and functional requirements instills confidence that a loss can be settled and the equipment owner made whole.

For more information on how professional equipment recovery is performed on crypto mining equipment, contact AREPA at recovery@arepa.com or (855) 483-5776.

RESOURCES & REFERENCES

1. Jordan Tuwiner, "Bitcoin Mining Hardware ASICs (/mining/hardware/)", https://www.buybitcoinworldwide.com/mining/hardware/, 2021
2. Dr. Garrick Hileman, Michel Rauchs, "Global Cryptocurrency Benchmarking Study", Cambridge Centre for Alternative Finance, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2965436, 2017
3. Alex Kampl, "Analysis of Large-Scale Bitcoin Mining Operations (or How Bitcoin Miners Make $845 Million a Year)", Allied Control, www.allied-control.com/publications/Analysis_of_Large-Scale_Bitcoin_Mining_Operations.pdf, 2014
4. Yassine Elmandjra, Derek Hsue, "Bitcoin Mining - The Evolution of A Multibillion Dollar Industry", ARK Invest, https://research.ark-invest.com/hubfs/1_Download_Files_ARK-Invest/White_Papers/ARKInvest_031220_Whitepaper_BitcoinMining.pdf, 2020
5. Cristina Criddle, "Bitcoin Consumes More Electricity than Argentina", BBC News, https://www.bbc.com/news/technology-56012952, 2021
6. Unocoin, " Bitcoin Miners Bitcoin Nodes", https://blog.unocoin.com/bitcoin-miners-vs-bitcoin-nodes-6a4d35be9712, 2018
7. Peter Hakenen, "Bitcoin Mining Facilities - What Property Insurers Should know", Gen Re, https://www.genre.com/knowledge/blog/bitcoin-mining-facilities-what-property-insurers-should-know-en.html, 2021
8. Corrie E. Clark, Heather L. Greenley, "Bitcoin, Blockchain, and the Energy Sector", Congressional Research Service, https://crsreports.congress.gov/product/pdf/R/R45863, 2019
9. Rahul Sharma, "Almost Perfect: Can Anyone Really Deliver 'Five-Nines' Availability?", TechGenix, https://techgenix.com/five-nines-availability/, 2019
10. Lionel Laurent, "Bitcoin is an Incredibly Dirty Business", Bloomberg, https://www.bloomberg.com/opinion/articles/2021-01-26/is-bitcoin-mining-worth-the-environmental-cost, 2021
11. Bill Kosik, "Data Centers Used for Bitcoin Mining", Consulting - Specifying Engineer, https://www.csemag.com/articles/data-centers-used-for-bitcoin-mining/, 2018
12. Turner Wright, "Samson Mow: Bitmain S17/T17 Antminer has High Failure Rate", Cointelegraph, https://cointelegraph.com/news/samson-mow-bitmain-s17-t17-antminer-has-high-failure-rate, 2020
13. Elizabeth Mcauley, "How Many Bitcoins will be Created?", The Hartford, https://sba.thehartford.com/finance/cryptocurrency/how-many-bitcoins-will-be-created/, 2021
14. Susanne Kohler, Massimo Pizzol, "Life Cycle Assessment of Bitcoin Mining", Aalborg University, https://pubs.acs.org/doi/pdf/10.1021/acs.est.9b05687, 2019
15. Nick Beecroft, "Bitcoin - Risk Factors for Insurance", Lloyd's, https://www.lloyds.com/~/media/files/news%20and%20insight/risk%20insight/2015/bitcoin%20%20final.pdf, 2015
16. "Mining Rig Maintenance: Dust Removal", GPU0, https://gpu0.com/mining-rig-maintenance-dust-removal/, 2018
17. Daniel Kuhn, "Pan-African Insurer Old Mutual will not Insure Mining Rigs", Coindesk, https://www.coindesk.com/pan-african-insurer-old-mutual-will-not-insure-south-african-mining-rigs, 2019
18. Patrick Nohe, "How Strong is 256-bit Encryption", hashed out by The SSL Store, https://www.thesslstore.com/blog/what-is-256-bit-encryption/, 2019
19. Zack Voell, Bitcoin Mining Machine Shortage Worsens as Bitmain Sells Out Through August", Coindesk, https://www.coindesk.com/bitcoin-asic-mining-shortage-bitmain-sold-out, 2021
20. Matthew Wegar, Jared Fegan, Paul Savage, Envista Forensics, https://www.envistaforensics.com/
21. Colin Harper, "Mining like a Viking: How the Fjords of Norway Offer a Greener Alternative", Bitcoin Magazine, https://bitcoinmagazine.com/business/mining-viking-how-fjords-norway-offer-greener-alternative, 2018

22. University of Cambridge Judge Business School, Cambridge Bitcoin Electricity Consumption Index, https://cbeci.org/
23. Ty R. Sagalow, “Insuring Bitcoin Technology”, Insurance CIO Outlook, https://broker-management.insuranceciooutlook.com/cxoinsights/insuring-bitcoin-technology-nid-35.html
24. Digiconomist, Bitcoin Energy Consumption Index, https://digiconomist.net/bitcoin-energy-consumption/
25. Andrew Nikiforuk, “The Big Shift Last Time: From Horse to Car Smog”, The Tyee, https://thetyee.ca/News/2013/03/06/Horse-Dung-Big-Shift/
26. Mark Felsenthal, Ryan Hahn, “Financial Inclusion on the Rise, but Gaps Remain, Global Database Shows”, The World Bank, https://www.worldbank.org/en/news/press-release/2018/04/19/financial-inclusion-on-the-rise-but-gaps-remain-global-findex-database-shows
27. Katrina Kelly-Pitou, “Bitcoin’s Energy Consumption Isn’t as Bad as You think”, Quartz, https://qz.com/1364657/bitcoins-energy-consumption-isnt-as-bad-as-you-think/
28. Jamie Redman, “Bitcoin Energy Consumption is Far More Efficient and Greener Than Today’s Banking System”, Bitcoin.com, https://news.bitcoin.com/bitcoin-energy-consumption-is-far-more-efficient-and-greener-than-todays-banking-system/

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