

Cryptocurrency Miners

Can a select few escape the volatility and generate sustainable shareholder returns?

Elwood Research Series
04 February 2020



Elwood Asset Management LLP



About Elwood Asset Management

Elwood Asset Management (“Elwood”) is an investment firm specialising in providing investors exposure to digital assets and blockchain technologies.

The Elwood Blockchain Global Equity Index aims to offer exposure to listed companies that participate or have the potential to participate in the blockchain or cryptocurrency ecosystem. The index aims to capture the potential investment upside generated by earnings related to the adoption of blockchain technologies or cryptocurrency. It is designed to evolve with the future development of the blockchain space.

The index is independently calculated and distributed by Solactive and is reviewed and rebalanced quarterly.

Invesco has partnered with Elwood to launch an ETF and a Japan domestic mutual fund that aim to deliver the performance of the Elwood Blockchain Global Equity Index by physically investing in the index constituents.

Index

Ticker	Name
BLOCK Index	Elwood Blockchain Global Equity Index

ETF

Ticker	Exchange
BCHN LN	London Stock Exchange - USD
BCHS LN	London Stock Exchange - GBP
BNXG GY	Börse Frankfurt - EUR
BCHN IM	Borsa Italiana - USD
BCHE SW	SIX - USD

Investment Fund

Japan domestic mutual fund
Invesco World Blockchain Equity Fund

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Abstract

In this report we seek to shed light on the four publicly listed cryptocurrency mining stocks: Hut 8 Mining, Bitfarms, Hive Blockchain Technologies and Argo Blockchain. We evaluated the miners using our own custom EBIT measure, which applied the same depreciation policy across all the companies. Using this methodology one can compare the profitability of the companies, while normalising for differences in depreciation policies or the timing of impairments, which can be quite significant due to the large expenditure on mining equipment. Our analysis shows that Hut 8 Mining was the most capital efficient listed cryptocurrency miner during 2019, as it was the only profitable company on our adjusted EBIT basis. This is a very different picture than one would get by looking at the reported EBIT figures. In addition, our analysis suggests that the remaining listed mining companies are placed too high in the mining cost curve, leading to poor capital returns and negative free cash flow generation. Bitcoin's block reward halving in May 2020, could exacerbate the challenges some of these listed miners are facing. However, we think there are still investment opportunities available in this \$5 billion a year industry, one just needs to be highly selective.

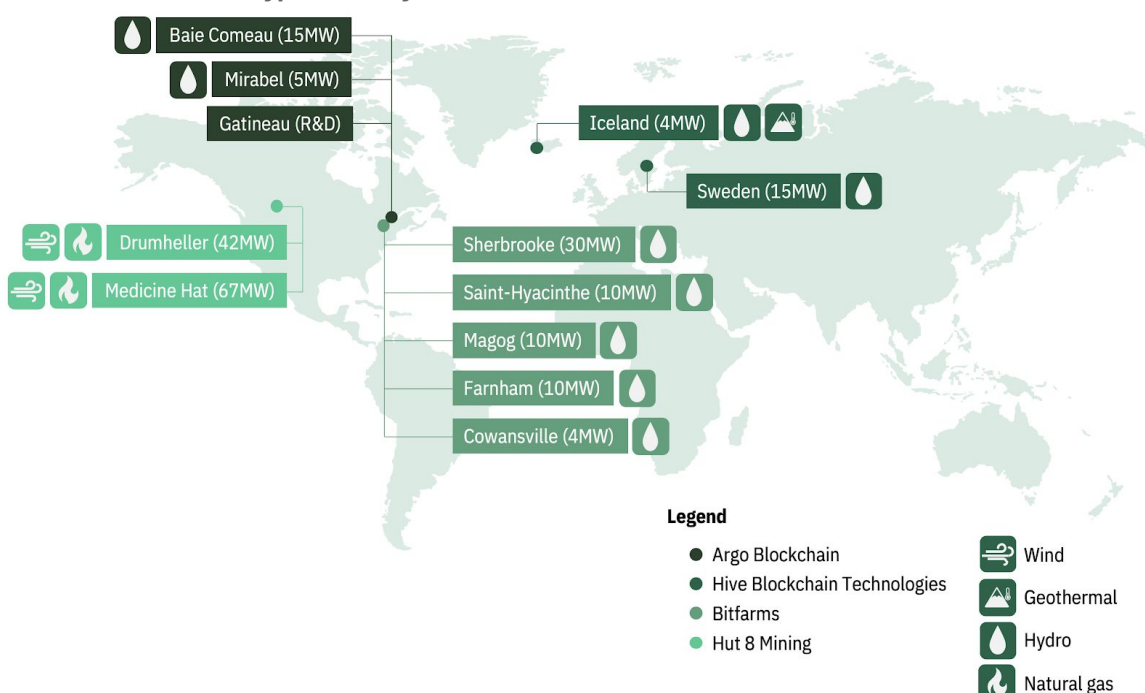
Ticker	Company	Market Cap (US\$m)	Total mining capacity* (MW)	SHA-256 hash rate* (PH/s)	H1 2019 Gross mining margin**	H1 2019 adj. EBIT margin
HUT CN	Hut 8 Mining	109.4	107	952	43%	16%
BITF CN	Bitfarms	39.8	64	813	63%	(71%)
HIVE CN	Hive Blockchain	42.0	24	100	30%	(188%)
ARB LN	Argo Blockchain	26.1	64	581	51%	(6%)

(Source: Market Cap, Bloomberg, data as of 30/01/2020, mining capacity and hash rate from company website as of 30/01/2020, ** only including electricity and hosting costs for mining)

Introduction

Companies in the blockchain space have managed to raise a significant amount of capital, however most are still privately held. The same applies to the cryptocurrency miners, with the exception of four of them, which have become listed in Canada and the UK. In this report, we aim to evaluate them and assess the investment opportunities.

Geographic distribution of listed cryptocurrency miners



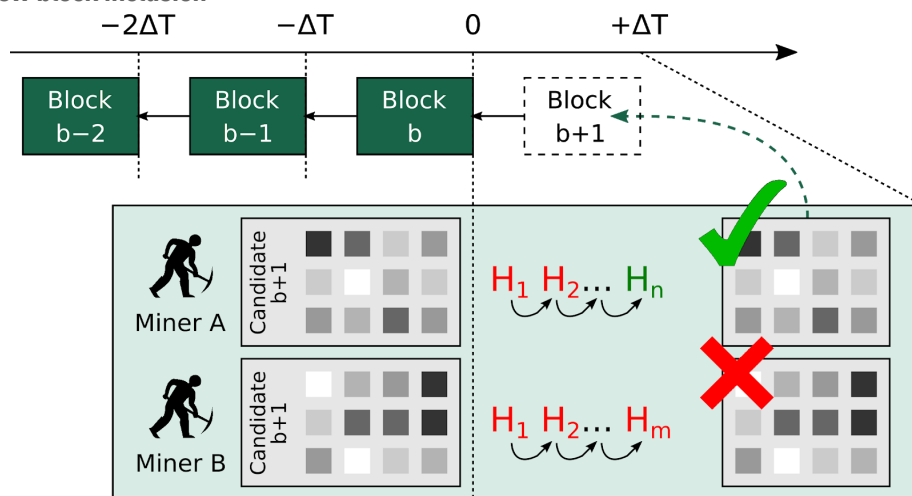
(Source: Elwood research)

What is Bitcoin mining?

Bitcoin is an electronic currency, aiming to capture some of the peer to peer like characteristics of physical cash, by avoiding third party financial intermediaries when engaging in electronic transactions. Bitcoin uses a peer-to-peer network of nodes to generate, process and distribute transactions. Miners are nodes with a very specific role: update the public ledger by packaging new transactions into a block of transactions. Miners compete to update the public ledger by trying to build their own block proposal. This process prevents the inclusion of conflicting valid transactions in the public ledger, by a quasi random competitive process, thereby avoiding a centralised third-party financial intermediary to resolve these conflicts.

The mining competition involves the use of highly intensive processing resources to solve a mathematical puzzle: the first miner who solves it disseminates the new block into the network. Every validating node will independently verify the correctness of the information inside the block. The diagram below shows a simplified mining process with two miners.

Mining process and new block inclusion



(Source: Elwood research)

In case of success, every node links the new block ($b+1$ in the diagram above) to the previous block considered to be the last mined (b), forming an ever-growing blockchain. The competition will then start over with new block proposals containing transactions not yet included in the current state of the blockchain. As noted before, different miners may produce blocks containing different sets of transactions (shaded squares within candidate blocks in the diagram). Each puzzle attempt is represented by an operator H (i.e. hash). Miner A solves the puzzle for block $b+1$ after n attempts (H_n).

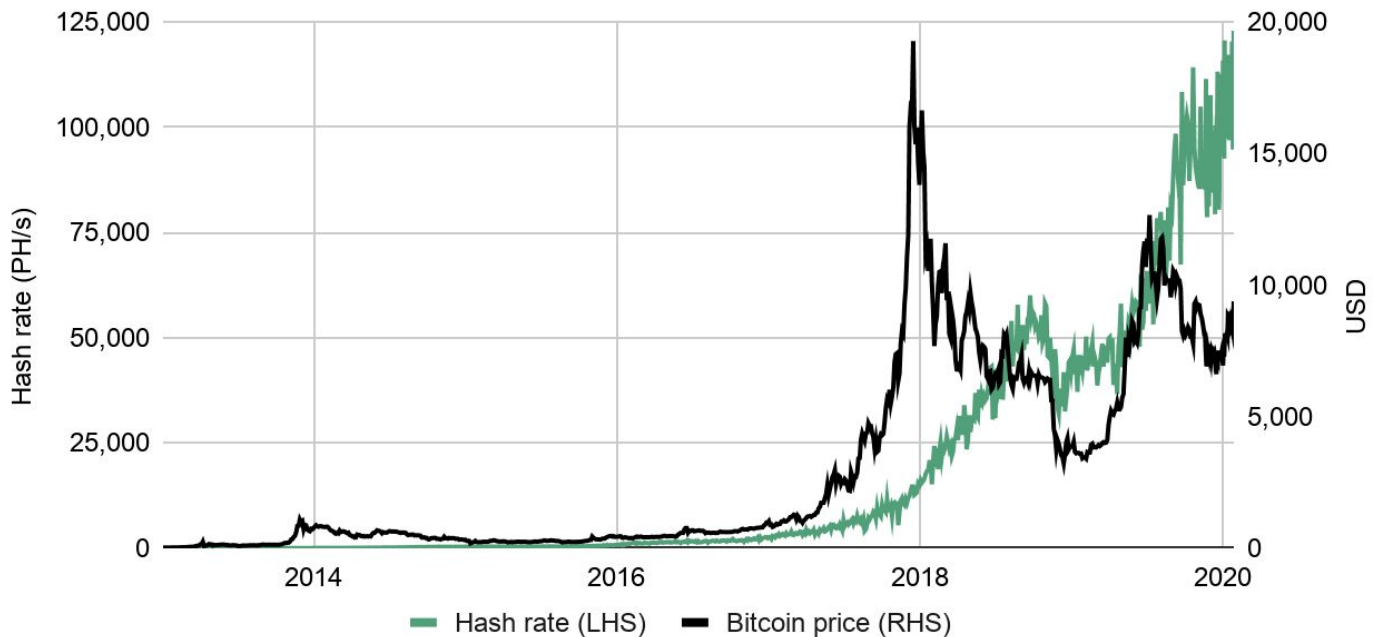
Mining requires significant investment to purchase state-of-the-art hardware and perform efficient computations to remain competitive. The activity is supported by an **economic incentive**: the miner who solves the puzzle is rewarded with a specific amount of newly minted bitcoin, in addition to the sum of all the transaction fees for the transactions included in the block.

Miners are also compelled to play by the rules: mining is expensive and miners are rewarded in the underlying mining currency, Bitcoin. The amount of new minted bitcoin is set by the protocol and cannot be modified. If a dishonest miner tries to award themselves with a higher number of bitcoin, every node in the network will automatically reject the proposed block. In this case, the dishonest miner will have wasted computational resources for mining a block which would not have been accepted by the network.

Bitcoin mining is designed to be an open and competitive process. However, there are some economies of scale, that therefore significant investments may be required in order to achieve meaningful profits.

Miners use a considerable amount of electricity power (measured in Watts) and power cost is one of the key profitability drivers. Mining operations performance is measured in *hashes per second* (H/s), which is the number of attempts to solve the puzzle each second. The chart below shows the growth of the Bitcoin network hash rate over time, which is analogous to the amount of computing power being used to secure the network.

Bitcoin hash rate and price since 2013



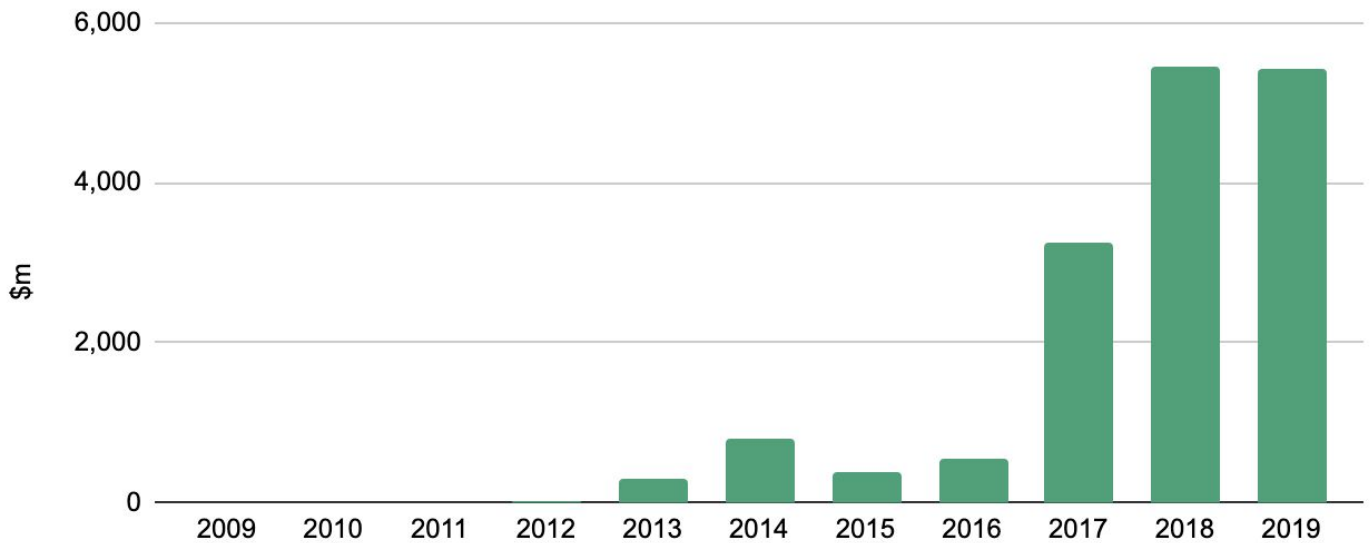
(Source: Blockchain.com)

Overview of the Bitcoin mining industry

With the significant price appreciation of Bitcoin since its inception in 2009, the Bitcoin mining space has grown into a professional and large-scale industry. The total Bitcoin mining revenue for the year of 2018 was over \$5.3bn, as shown below, and since Bitcoin was first launched in 2009, a total of \$15bn in revenue has been earned by miners. This is therefore a reasonably large industry, which does present opportunities for investors and entrepreneurs.

However, as the industry is relatively new, many investors and businesses have struggled to allocate capital in a sensible way, by failing to appreciate the cycles and nuances in the industry. However, we think it is possible to build a robust and sustainable business if one can lower their costs and place themselves within the lower end of the cost curve. As with most mining operations, digital or not, being in such a position can lead to stable levels of earnings, despite the high degree of volatility in the underlying cryptocurrency.

Annual Bitcoin mining revenue



(Source: Bloomberg, Quandl)

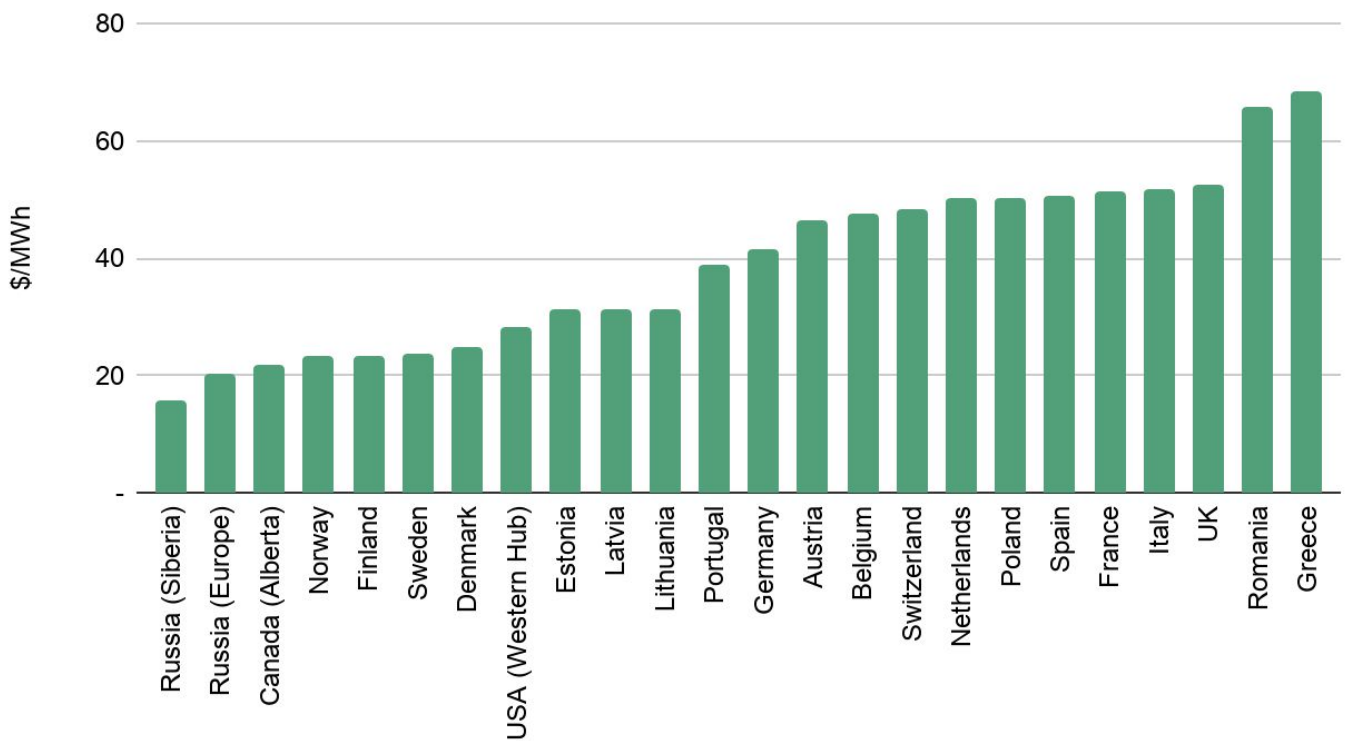
Factors that impact mining profitability

The main factors which impact a cryptocurrency miner's profitability are:

- **Cost of electricity and supply stability.** These factors have a large role in determining cryptocurrency mines are located. Firms aim to operate mining farms in areas with constant and cheap electricity supply (typically less than \$50/MWh). For instance, regions with abundant hydroelectric power are particularly desirable as the marginal cost of power generation is very low, while power is reliable and stable.
- **Efficiency and reliability of hardware.** This factor is determined by the type of hardware the company has deployed as well as its ability to keep the equipment up to date and well maintained in order to maximise uptime and performance. In addition to other costs (e.g. cooling, staff and administration costs), higher end hardware is more expensive to acquire and requires constant investment and upgrades in order to keep efficiency levels.

Miners need cryptocurrency friendly jurisdictions with cooler climates and, as defined above, cheap electricity to achieve the best operating performance. Given the significant share of electricity within mining costs, it comes as no surprise that geographies offering the cheapest electricity are the preferred ones by cryptocurrency miners (see chart below). The exception is Russia, which does have a suitable climate for mining operations, but legal barriers and international sanctions could create a challenging environment for miners.

Electricity prices in Europe and North America



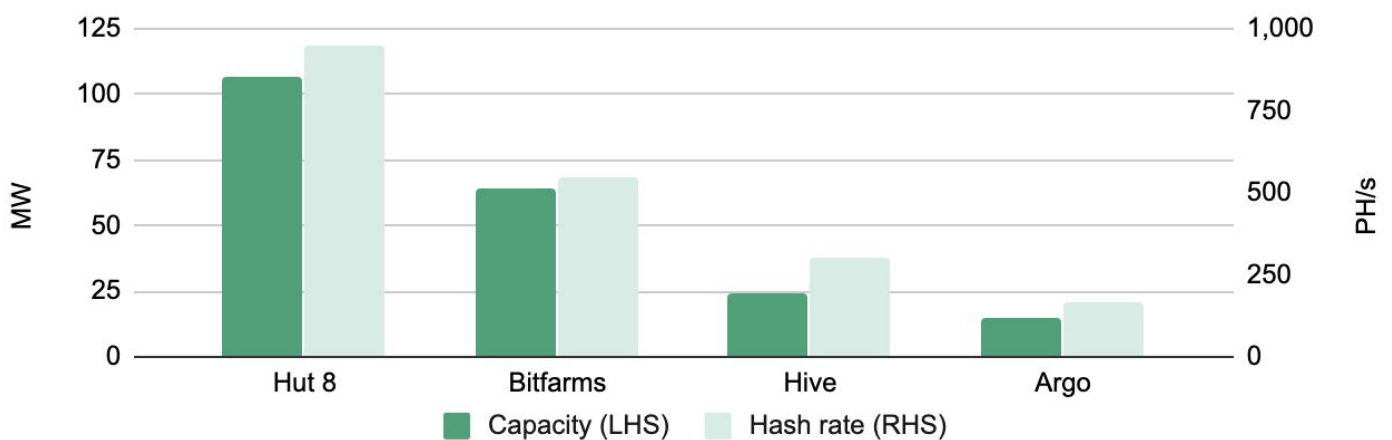
(Source: Elwood research, Bloomberg; as at 20 Jan 2020)

Note: although no comparable data is available, Statistics Iceland suggests power prices in the country are the lowest in the rest of the Nordic region.

Benchmarking cryptocurrency miners

In this section, we aim to benchmark the operating capacity and profitability of the four listed cryptocurrency mining companies. The largest listed miner is Hut 8, with 107MW of mining capacity, allowing the company to achieve a hash rate of 952 PH/s (petahashes per second).

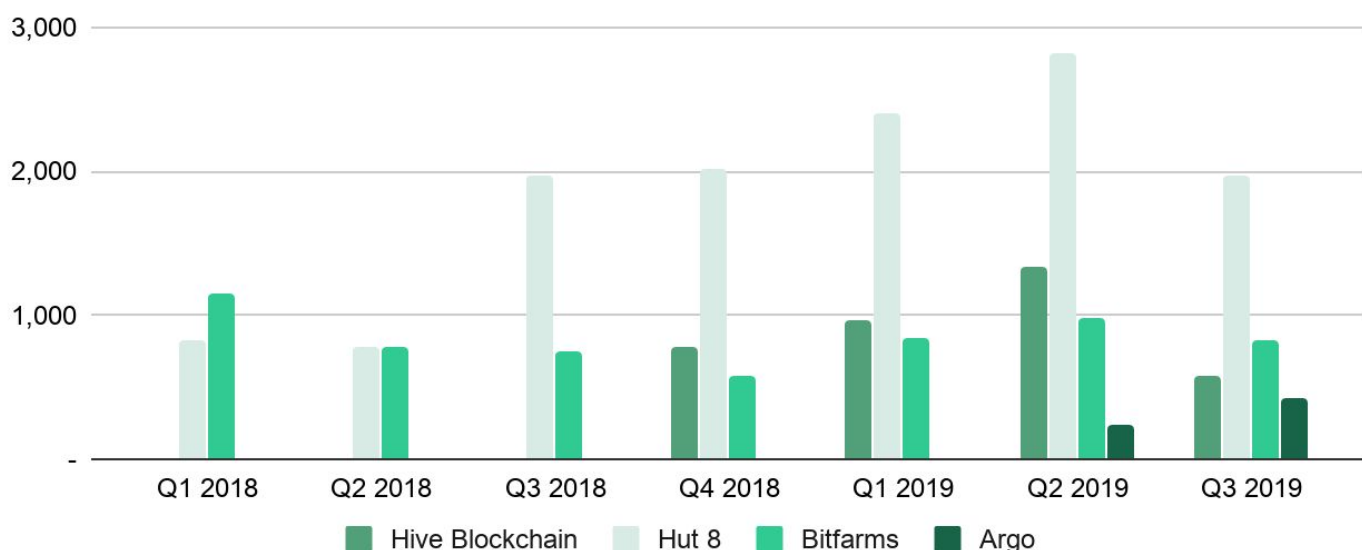
Listed cryptocurrency mining companies by mining capacity and hash rate



(Source: Bloomberg, company data)

As would be expected, the companies with the largest mining capacities and hash rates are also the ones that produce most bitcoin. Below, we show the quarterly number of mined bitcoin per company - Hut 8 mined 1,965 units in the quarter to September 2019, while Argo Blockchain had the lowest output, with 426 mined units.

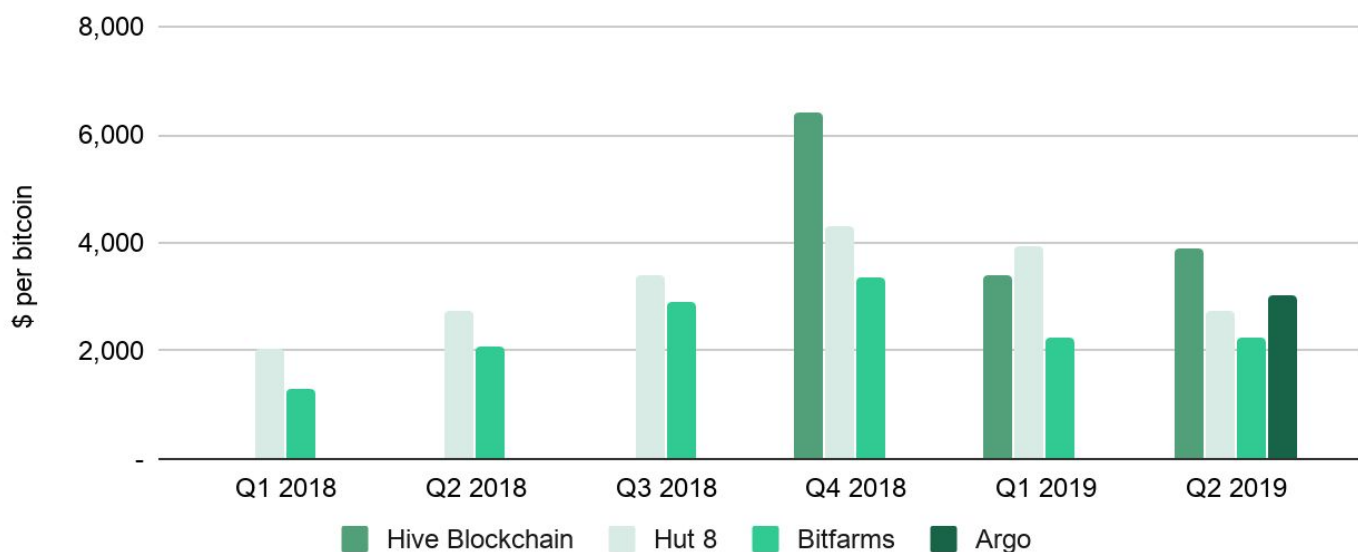
Amount of bitcoin mined per quarter



(Source: Elwood research, company data)

We have also analysed the gross cost per bitcoin mined, defined as the electricity cost to mine. Hive Blockchain has incurred the highest cost per mined bitcoin in the quarters to December 2018 (when it initiated Bitcoin mining) and June 2019. In contrast, Bitfarms has had the lowest electricity costs in five of the six quarters we have analysed.

Gross (electricity) cost per mined bitcoin



(Source: Elwood research, company data)

Despite some variations, mining costs seem to have hovered around or below \$4,000 for listed miners in 2019, well below the \$7,670 bitcoin price average over the past twelve months (as of 27 January 2020). A Bloomberg report¹ from January 2019 suggested Chinese companies were mining at around \$2,400 in Q4 2018, nearly 30% below the most efficient listed player in the period (Bitfarms). This suggests some of the listed miners are likely to be marginal

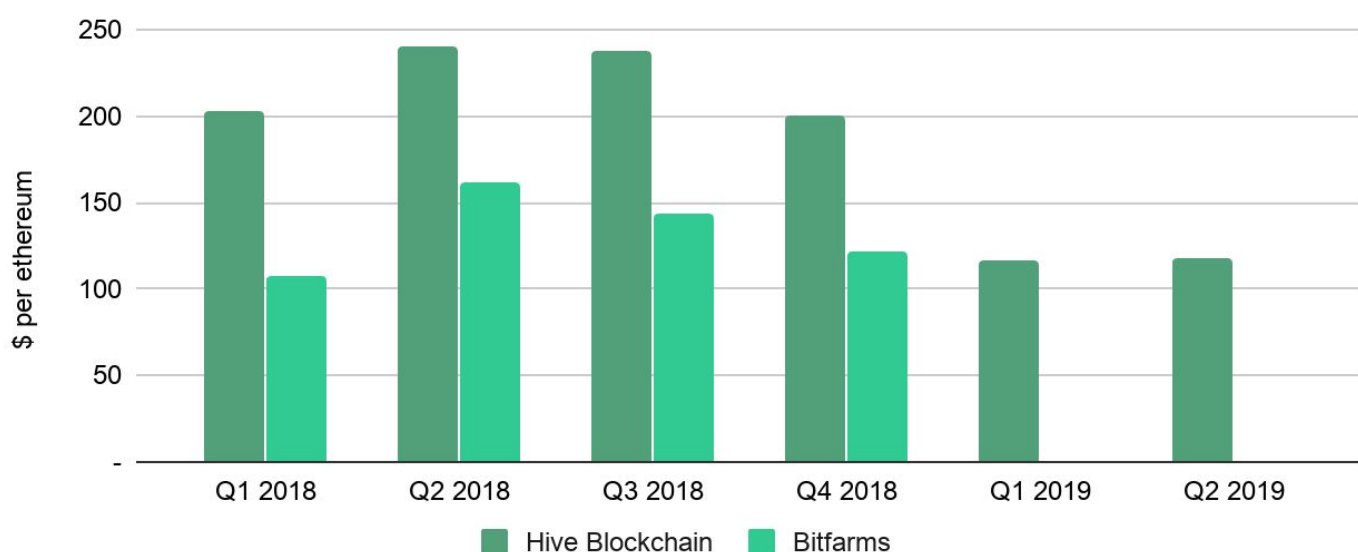
¹ Source: Bloomberg [\[link\]](#)

producers, and could become more loss making or even go out of business in the event of a large and prolonged downward price swing.

A considerable challenge is likely to arise in May 2020, when the Bitcoin mining reward is expected to half, from 12.5 bitcoin per block to 6.25 bitcoin per block. This means that, for the same input, miners will receive half the amount of currency they currently do. All else equal (e.g. Bitcoin price, average cumulative fees per block), this would lead miners to just break even on the gross profit level, leaving very little resources to cover for ongoing operating costs and reinvestment in the business. For miners with some cash availability, they could increase their competitiveness and remain in business by acquiring newer, more efficient equipment. Those with limited cash resources are likely to be pushed out of business, reducing the number of players in the industry. This adjustment would result in lower difficulty and increased earnings for the remaining miners, being especially beneficial for companies lower in the cost curve.

Some of the listed cryptocurrency miners also produce other coins, such as Ethereum, Litecoin, Dash, etc. Company reports allowed us to benchmark Ethereum, which used to be mined by Bitfarms and is still part of Hive’s mining portfolio. Throughout the January 2018 - June 2019 period, Ethereum mining costs ranged between \$100 and \$230, with the latest figures from Hive suggesting it cost the company around \$130 to mine one unit of Ethereum (ether).

Gross (electricity) cost per mined ether



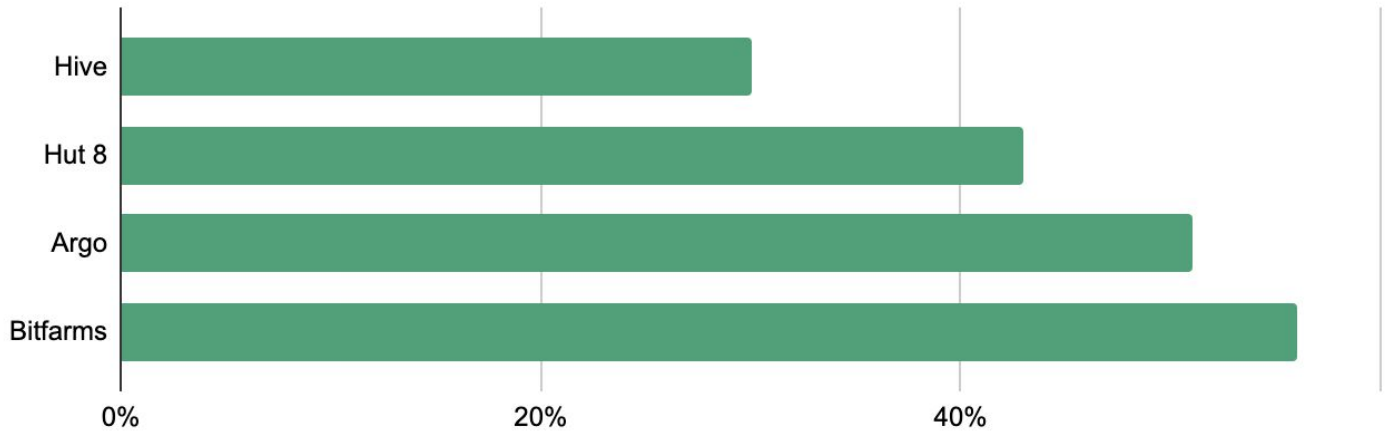
(Source: Elwood research, company data)

In order to benchmark the miners’ profitability, we have calculated a gross mining margin for the first half of calendar 2019, where:

$$\text{Gross mining margin} = \frac{\text{Mining revenue} - \text{cost of electricity}}{\text{Mining revenue}}$$

By this metric, Bitfarms comes at the top, with a H1 2019 gross mining margin of 56%, followed by Argo Blockchain, then Hut 8 and Hive Blockchain.

H1 2019 gross mining margin



(Source: Elwood research, company data)

EBIT adjustments and reworked depreciation schedule

However, power is not the only cost for cryptocurrency miners. We have calculated an adjusted EBIT margin which includes electricity costs, depreciation of mining equipment on a straight-line two year basis, salaries, maintenance costs and all general administration costs required to operate the business. Below we provide a summary on which expenses are included in each of the EBIT metrics:

	Reported EBIT	Adjusted EBIT
Adjusted depreciation and amortisation	✗	✓
Depreciation and amortisation	✓	✗
Energy and infrastructure	✓	✓
General, admin and other	✓	✓
Impairments	✓	✗
Maintenance costs	✓	✓
Marketing	✓	✓
Revaluation of digital currencies	✓	✗
Salary and benefits	✓	✓
Share based payments	✓	✗

In our analysis, we noticed that companies use different accounting policies to depreciate their mining assets, although the generally accepted approximate useful life for this type of hardware is two years². Based on each companies' capital expenditure history, we have reworked the depreciation schedules of Argo, Hive and Bitfarms in order to convert their policies to a two-year regime, reflecting the real world hardware lifetime expectations, while also removing the effects of discretionary accounting policies.

² Source: CoinShares Research [\[link\]](#)

Depreciation schedule by company

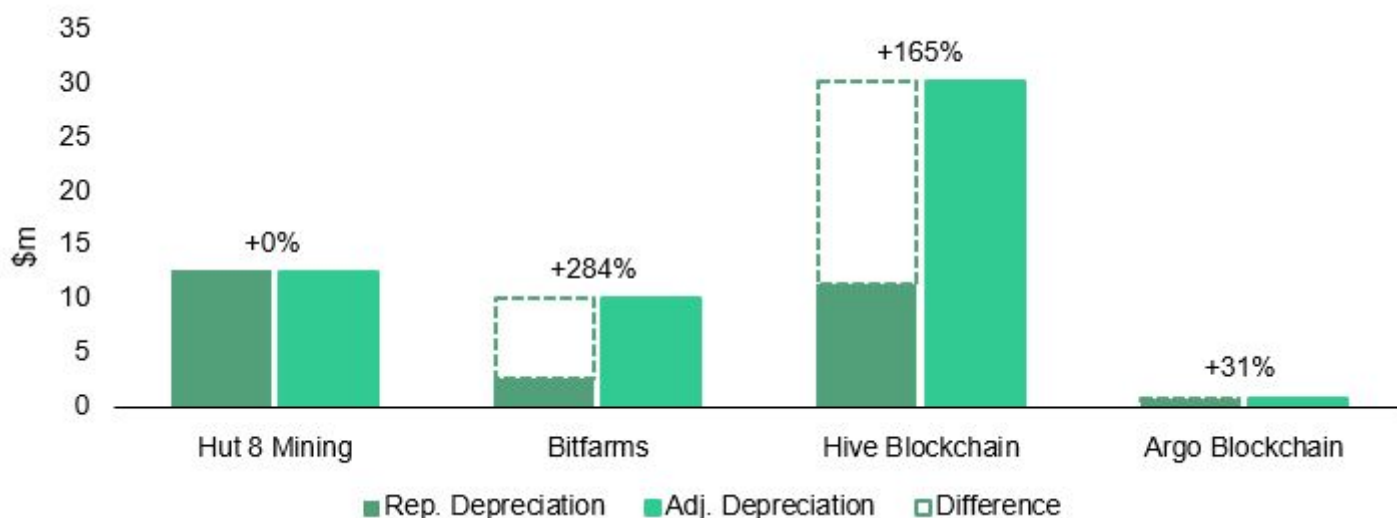
Company	Depreciation schedule used by company	Assumptions made in order to adjust
Argo Blockchain	3 years on a straight-line basis	\$18m of hardware bought in H1 2019 period was purchased in May
Bitfarms	Sum of years, declining over 5 years	Asset acquisitions occur at beginning of respective quarter
Hive Blockchain Technologies	4 years on a straight-line basis	Asset acquisitions occur at beginning of month stated
Hut 8 Mining	2 years on a straight-line basis	No assumptions or adjustments needed

(Source: company data)

It is important to note that, when adjusting each company's depreciation schedule, we had to make assumptions around the timing of hardware purchases (beginning of period) and that there would be no residual value in the end of their useful lifetimes.

As the chart below makes clear, the choice of depreciation policy can have a significant impact on depreciation expenses and, hence, profitability numbers. For some of the companies we analysed, the adjusted charge corresponds to a nearly 300% increase in the depreciation charge for the H1 2019 period. Although not a cash charge, depreciation does reflect the level of reinvestment that is required on the business, which looks to be much higher than reported by some companies, if we take into account an average lifetime for the hardware of two years rather than three or four.

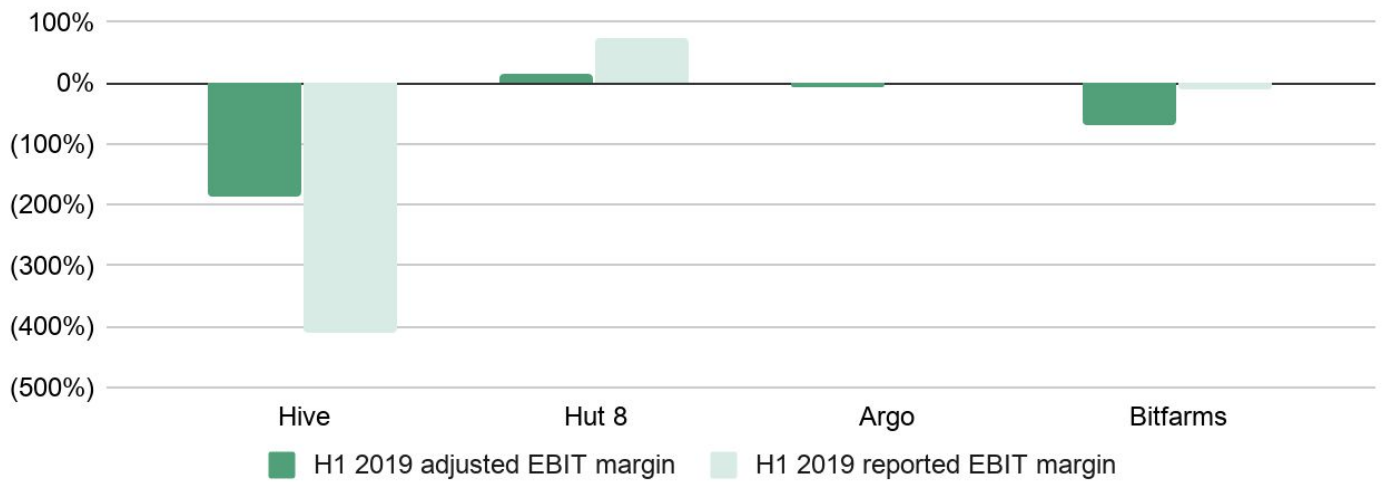
Impact of depreciation adjustments by company (H1 2019)



(Source: Elwood research)

The reworked depreciation charge has a considerable impact on the companies we have analysed, but it is not the only element we have adjusted to calculate our adjusted EBIT margin. As per the table in the beginning of this section, we also excluded from the adjusted EBIT any realised or unrealised gains from the revaluation of cryptocurrencies and impairments of mining equipment, as these do not reflect the true operating strengths of the businesses. By applying these adjustments, we were able to create the chart below, which shows the adjusted and reported EBIT margins for each firm during the H1 2019 period. It is worth noting that the reported EBIT margin does include impairments and revaluation of cryptocurrencies held as inventory.

H1 2019 EBIT margins



(Source: Elwood research)

During this period, Hut 8 Mining was the only company which had a positive adjusted EBIT margin, at 16%. However, it is important to highlight that this adjusted operating income excludes impairments and any revaluation of cryptocurrencies.

Valuation

Cryptocurrency mining farm operations remains a largely private company industry. The four listed entities covered in this report account for less than 2% of the global Bitcoin hash rate, with the likes of Bitfury, Genesis and Gigawatt remaining in private hands. The companies that are listed, however, are relatively small, with a combined market value of \$210m.

We have produced a peer group valuation table for the listed miners as per below. At this point, we can only analyse sales and EBITDA multiples, as in calendar 2018 and over the last twelve months, all companies have been loss-making on the operating level. We compare the stocks against gold miners, who are most likely the closest peers to cryptocurrency miners. The sector trades at an average 2.2x trailing twelve months sales, 33% below gold mining companies, who trade at 3.3x. With a trailing EV/EBITDA of 6.5x, the sector looks even more deeply discounted, against the gold miners' 11.2x trailing EV/EBITDA multiple.

Ticker	Name	Year end	Price (\$)	Market cap (\$m)	EV/Sales		EV/EBITDA	
					CY18	LTM	CY18	LTM
HUT CN	Hut 8 Mining	Dec	1.21	109	3.4x	2.1x	8.7x	5.2x
BITF CN	Bitfarms	Dec	0.48	40	1.5x	2.0x	3.1x	7.8x
HIVE CN	Hive Blockchain Tech.	Mar	0.13	42	1.4x	1.4x	10.1x	n.a.
ARB LN	Argo Blockchain	Dec	0.09	26	17.0x	3.5x	n.a.	n.a.
Average					5.8x	2.2x	7.3x	6.5x

(Source: Elwood research, Bloomberg)

Note: LTM corresponds to last twelve months, or the October 2018 to September 2019 period, except for Argo Blockchain (used July 2018 to June 2019)

In our view, there could be a few reasons for such a deep discount:

- **Loss-making companies:** all four listed cryptocurrency miners are currently loss making, which also translates into poor cash flow generation, with all companies burning cash. For instance, Hive lost around twice its market capitalisation in 2018.
- **Poor capital allocation and write-downs:** some of the cryptocurrency miners have started their operations during the cryptocurrency hype of late 2017, making large investments during the period. As Bitcoin and other cryptocurrency prices dwindled, the expected returns on their investments have drastically dropped, leading to hefty writedown charges and reduced profitability.
- **Governance issues:** conflicts between companies have not provided investors with a friendly and stable environment to invest in, with the added risk of reduced earnings given the high probability of deals falling through.

In addition to poor profitability, cryptocurrency miners will have to face the challenge of Bitcoin halving in May 2020, which adds to investors' cash generation concerns about these companies, as, with rewards halving, almost all of the listed names would barely be able to break even at a gross profit level (assuming current prices).

Hut 8 Mining

Ticker	Company	Market Cap (\$m)	Total mining capacity (MW)	Hash rate (PH/s)	H1 2019 Gross mining margin	H1 2019 adj. operating mining margin
HUT CN	Hut 8 Mining	109.4	107	952	43%	16%

Hut 8 is a Bitcoin-only mining company, listed in the Toronto stock exchange. It is the largest Bitcoin mining firm in North America and the largest publicly listed cryptocurrency miner, with a total of 107 MW of mining power.³ One of the motivations behind Hut 8 listing as a public company was to provide investors with a method of gaining exposure to the price of Bitcoin in a regulated manner. Therefore the firm tends to keep the majority of bitcoin that it mines as inventory.

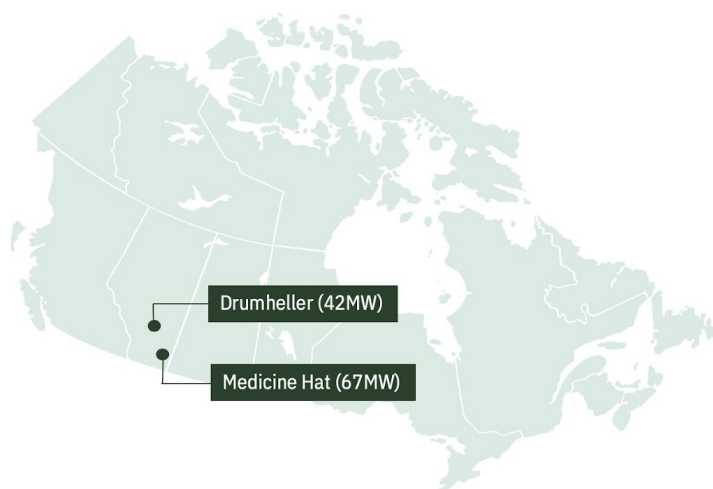
Corporate history

Hut 8 was founded by Andrew Kiguel and Bill Tai on November 14th, 2017.⁴ The company has a very close working relationship with Bitfury, a privately owned blockchain technology infrastructure firm. Bill Tai sits on the boards of both Bitfury and Hut 8, as does Jeremy Sewell - who is also the CFO of Bitfury. Hut 8's majority shareholder is Bitfury with a 47% stake and the relationship between the two firms is further outlined in a Master-Service agreement.⁵ Hut 8 listed on the Toronto Stock Exchange after a reverse takeover of Oriana Resources Corp.

Hut 8 has exclusive use of Bitfury's BlockBox cryptocurrency mining devices in North America.⁶ The BlockBox is a containerised data center for Bitcoin mining with air-cooled mining services that deliver a reported total hashrate of 14 PH/s per container.⁷ The chief benefit of this design is the portability of the mining servers so that equipment can be easily transported to a cheaper electricity location.

Hut 8 operates two mining locations, both in the Canadian province of Alberta. The largest operation is located in Medicine Hat, with a maximum capacity of 67MW and the second site is in Drumheller with 42.4 MW.

Hut 8 mining locations



(Source: Elwood research, company data)

³ Source: Hut 8 website [\[link\]](#)

⁴ Source: Hut 8 articles of inception [\[link\]](#)

⁵ Source: Bloomberg as of 05/11/2019

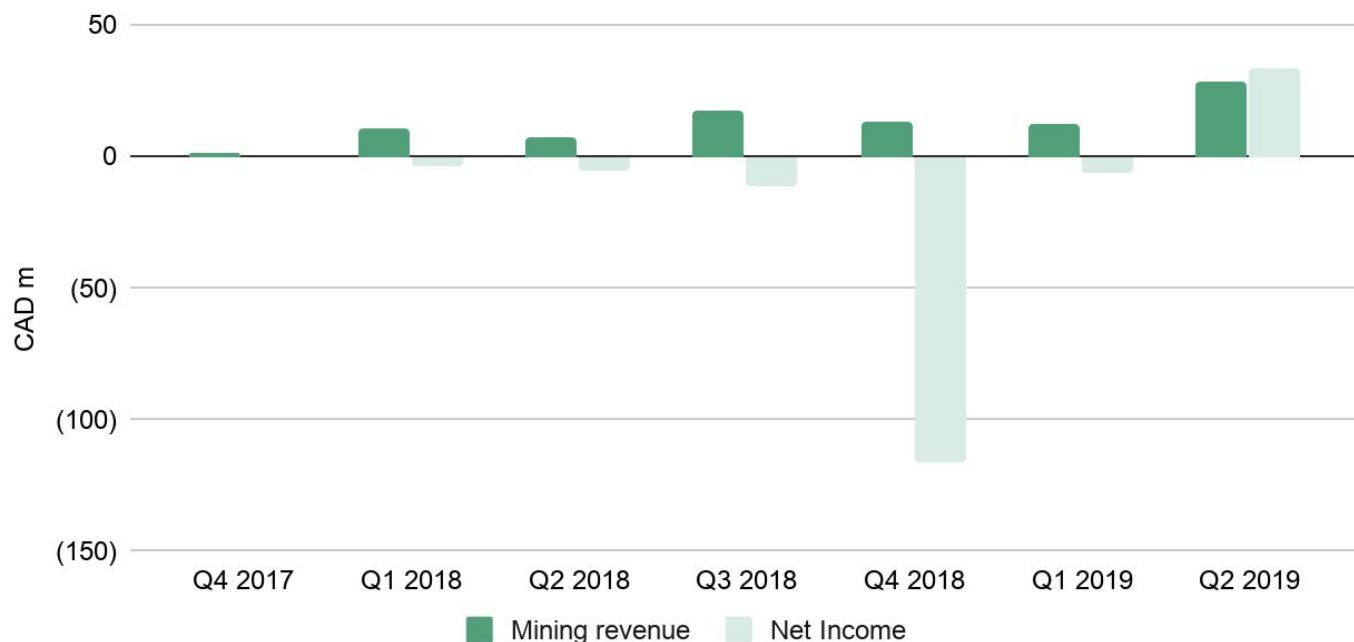
⁶ Source: Hut 8 Q4 2018 MD&A

⁷ Source: Bitfury website [\[link\]](#)

Financial Analysis

Hut 8 commenced mining operations on 15th November 2017 and quarterly revenues and net income can be viewed below:

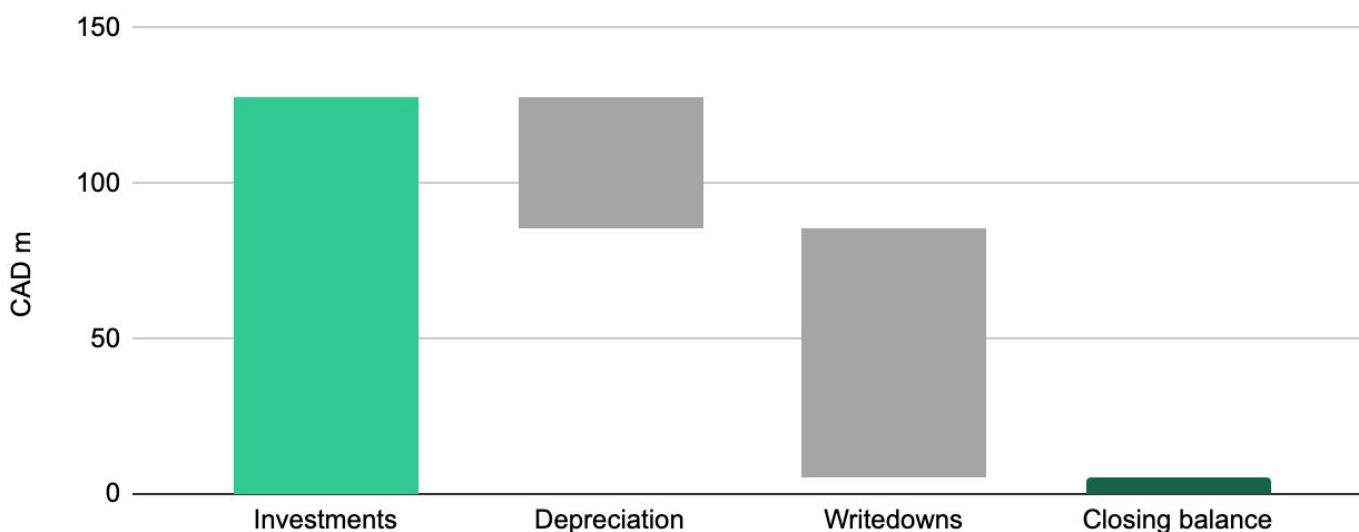
Hut 8 mining revenue and net income



(Source: company data, Elwood research)

The chart above shows a considerable profit slump in Q4 2018, despite generating similar levels of revenue against the previous quarter. This is the result of a CAD 84m inventory write-down during the period, shown in the figure below.

Fixed asset investments versus depreciation and writedowns (Nov 2017 - Sep 2019)



(Source: company data, Elwood research)

Hut 8 raised CAD 23.8m and CAD 54.9m from share issues in Q4 2017 and Q1 2018 respectively and drew CAD 20.6m

out of a loan from Bitfury. Management claimed that the CAD 84m inventory writedown was due to the “decline in market value of servers, weakening prices of Bitcoin and volatility in network difficulty levels during the year,”⁸ but it corresponds to over 85% of the company’s historical cumulative cash flows and more than half the investment on PP&E in the period. Hut 8 determined the recoverable amount as the fair value for the Drumheller facility (42.4 MW) and value in use for the Medicine Hat facility (67 MW) using the following assumptions:

- Bitcoin price = CAD 5,224 (\$3,829)
- Network difficulty = 5,619 billion
- Discount rate of mining servers = 25%

Below, we show a summary of Hut 8’s historical financials and mining output:

Hut 8 summary financial metrics

Metric	2017 (Nov 15 - Dec 31)	2018 (to Dec 31)	2019 (to Jun 30)
Number of BTC mined	62	5,592	5,341
Electricity costs (\$m)	0.10	29.8	17.3
Gross cost of BTC mined (\$)	1,635	3,423	3,246
Adjusted EBIT (\$m)	0.12	(21.4)	4.9
Adjusted cost of BTC mined (\$)	11,971	22,432	4,775
Reported EBIT (\$m)	0.12	(37.9)	21.1

(Source: Elwood research, company data)

As Hut 8 only mines Bitcoin, we can attribute 100% of electricity costs to Bitcoin mining in order to calculate the gross cost per bitcoin mined. Hut 8’s reporting currency is the Canadian dollar and we have used the period average exchange rates to convert the figures into US dollars.⁹

Being the largest of the listed miners, Hut 8 has mined over twice as many bitcoin per quarter than Bitfarms, the second largest listed player. This has provided the company with enough scale to dilute fixed costs, leading it to report the highest EBIT margins for the first half of 2019, as well as some of the lowest electricity costs per mined unit in the industry.

Bitfarms

Ticker	Company	Market Cap (\$m)	Total mining capacity (MW)	Hash rate (PH/s)	H1 2019 Gross mining margin	H1 2019 adj. operating mining margin
BITF CN	Bitfarms	39.8	64	813	63%	(71%)

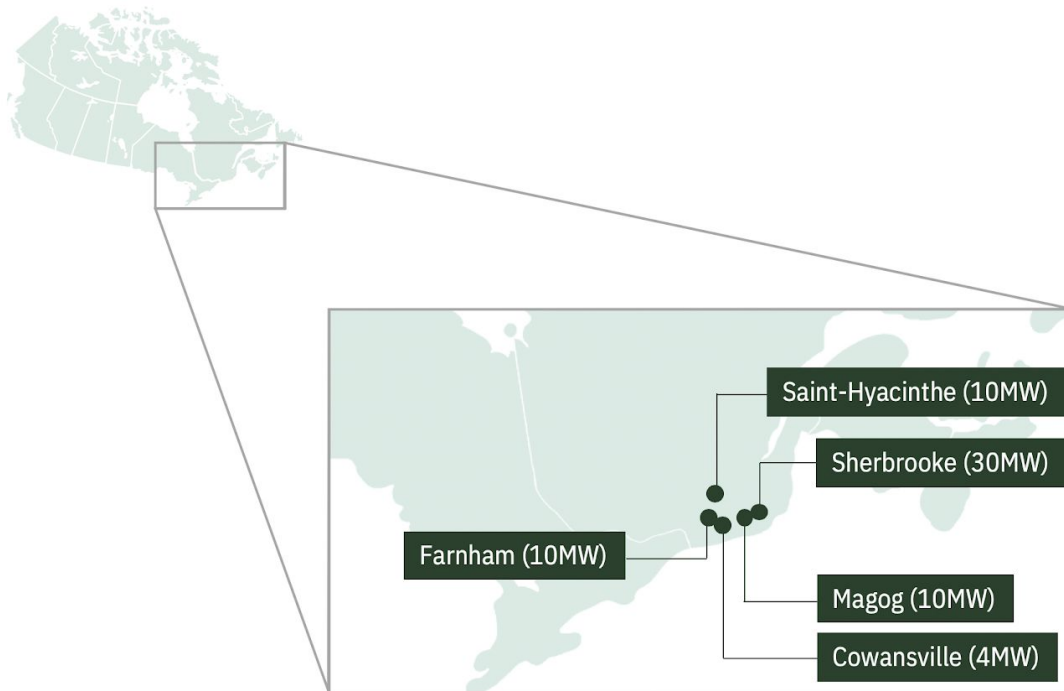
⁸ Source: Hut 8 Q4 2018 Financial Statements [\[link\]](#)

⁹ Source: OFC yearly average rates [\[link\]](#)

In January 2018, Israel-listed company Blockchain Mining Ltd acquired Backbone Hosting Solutions Inc., a Canadian Bitcoin mining company and changed the resulting company name to Bitfarms.¹⁰ Later in 2019, Bitfarms moved the listing to the Toronto Venture Exchange and filed a prospectus with the Ontario Securities Commission.

Today, Bitfarms operates five cryptocurrency mining facilities in Quebec, Canada: a 4MW capacity facility in Cowansville, 10MW in Farnham, 10MW in Magog, 10MW in Saint-Hyacinthe, and a newly built facility in Sherbrooke, which has a total capacity of 60MW, of which 30MW of mining power is currently operating.¹¹

Bitfarms Mining Locations



(Source: Elwood research, company data)

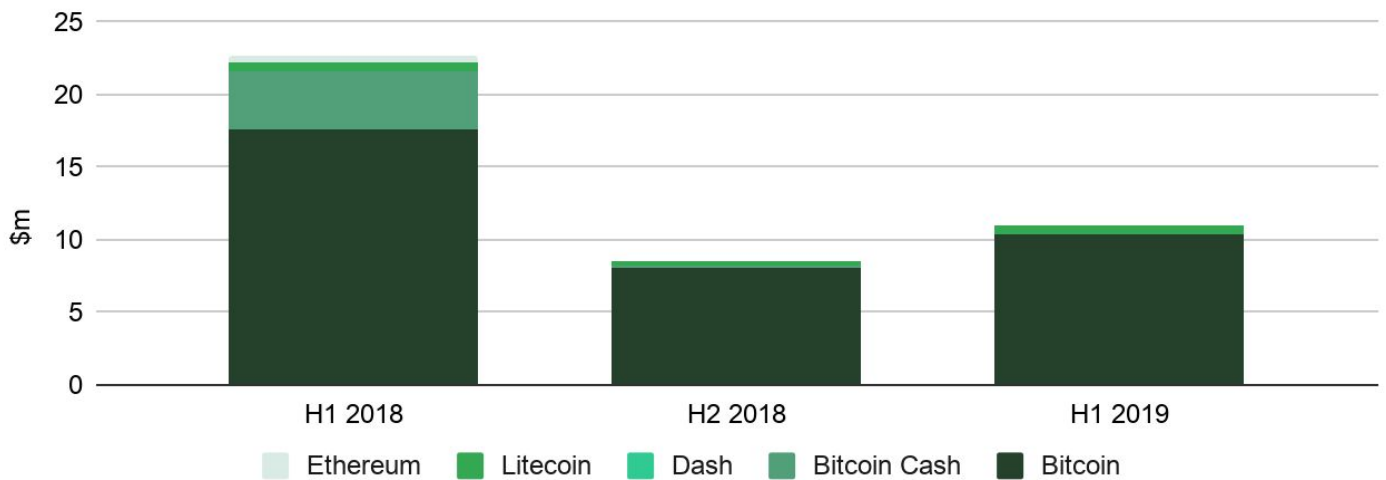
The five facilities add up to 64 MW of mining power, which generates 813 PH/s, with a total contracted power portfolio of 160 MW, should the company wish to expand their operations.¹² According to Bitfarm's website, 100% of their ASIC hardware is dedicated to mining on the Bitcoin network, however the firm has historically mined other cryptocurrencies as shown in the chart below.

¹⁰ Source: Intrade news [\[link\]](#)

¹¹ Source: Bitfarms website [\[link\]](#)

¹² Source: Bitfarms website [\[link\]](#)

Fair value of coins mined (\$m)



(Source: company data)

In relation to other cryptocurrencies, the proportion of Bitcoin has increased over time and, for the previous two half years, Bitfarms only mined Bitcoin and Litecoin.

Below, we have estimated the company's cost of mining Bitcoin. In order to do so we have made several assumptions:

- 1) Assumed that Bitfarms has the same mining margin for all coins that it has mined (Bitcoin, Bitcoin Cash, Dash, Litecoin and Ethereum).
- 2) Assumed that the entirety of 'energy and infrastructure' costs correspond to cryptocurrency mining electricity costs.
- 3) For 2017, attributed the same value proportion of 'energy and infrastructure' spent on Bitcoin mining as the proportion of the fair value of bitcoin mined in relation to the total cryptocurrency value mined; for 2018 and 2019, Bitcoin 'energy and infrastructure' costs have been obtained by multiplying reported Bitcoin break even cost (gross cost of bitcoin mined) by the number of bitcoin mined

Taking the 2017 period as an example. Bitfarms mined a total of 550 bitcoin, with a fair value of \$6,626,000. This represented 62% of the total value of all the cryptocurrency mined by the company in the period. Therefore we have attributed 62% of the total 'energy and infrastructure' costs of \$673,000 to Bitcoin mining, which is \$420,569, resulting in an implied gross Bitcoin mining cost of \$765 per unit.

We have used a similar methodology in order to calculate the total Bitcoin operating costs, which includes all operating costs (energy and infrastructure, adjusted depreciation, general and administrative expenses and impairments).

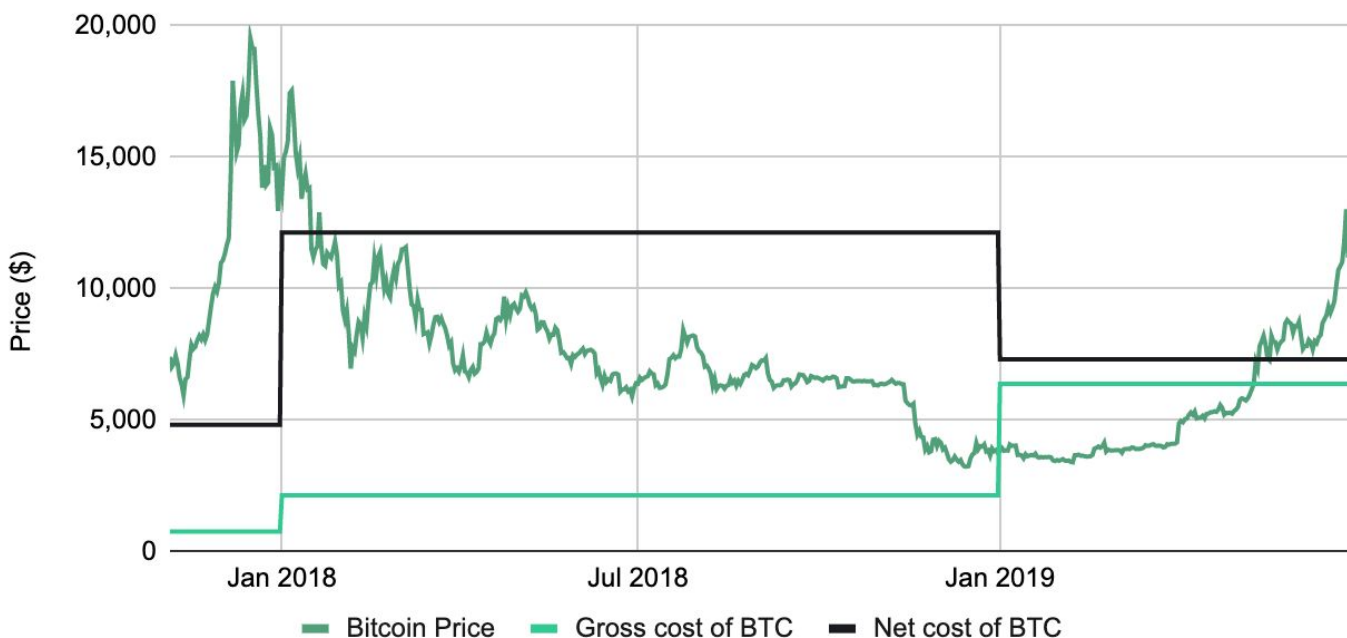
Bitfarms summary mining metrics

Metric	2017 (from 5th Nov)	2018	2019 (up to 30th June)
Number of BTC mined	550	3,252	1,811
BTC electricity costs (\$)	420,569	6,243,840	4,070,912
Gross cost of BTC mined (\$)	765	1,920	2,248
Adjusted EBIT (\$)	4,413,313	2,881,345	(1,761,184)
Net cost of BTC mined (\$)	4,829	12,126	7,307

This methodology has some drawbacks since it assumes that Bitfarms mine all cryptocurrencies with the same efficiency, an assumption which may be inaccurate. However, since Bitfarms does not provide a breakdown of costs for each cryptocurrency mined, this is the closest possible approximation derived from public information.

Below we have overlaid Bitfarm’s gross and net cost of mining Bitcoin with the prevailing market price for the analysed period. It is possible to conclude that the difference between the gross and net cost of Bitcoin mining increased during 2018, a result of several impairments recorded by Bitfarms throughout the year, which are included in the net cost.

Bitcoin price vs. mining costs



Hive Blockchain Technologies

Ticker	Company	Market Cap (\$m)	Total mining capacity (MW)	Hash rate (PH/s)	H1 2019 Gross mining margin	H1 2019 adj. operating mining margin
HIVE CN	Hive Blockchain	42.0	24	100	30%	(188%)

Hive Blockchain Technologies became the first listed cryptocurrency miner in the world when it listed on the TSX Venture Exchange in Canada on 15th September 2017. The first mover advantage has drawn significant attention to Hive’s stock during the cryptocurrency bull run of 2017 and the firm eventually hit a market capitalisation of \$2bn on 3rd November 2017.¹³

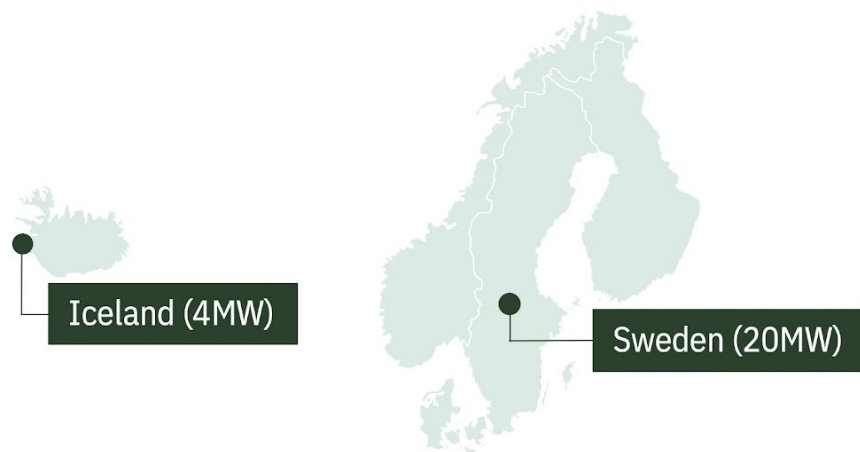
Hive was co-founded by Marco Streng (CEO of Genesis Mining) and Olivier Newton and has had a strategic partnership with Genesis Mining since inception. Genesis is a private company founded in 2013 which provides mining-as-a-service

¹³ Source: Bloomberg

to their clients and has claimed that over 2 million customers have used their cryptocurrency mining services.¹⁴ In September 2017, Hive signed a Master-Service Agreement with Genesis Mining in order to receive cryptocurrency mining facilities for a fixed monthly fee, covering all the costs associated with the mining operation, such as electricity, hardware and maintenance costs.¹⁵

As laid out in the agreement, there are cryptocurrency mining facilities in Iceland and Sweden in which Hive owns the mining machines purchased from Genesis, while Genesis hosts and maintains these machines. These specific locations were chosen because of the cold weather, in order to minimise cooling costs, and for the access to stable and cheap electricity. The agreement and partnership with Genesis Mining was highly beneficial for Hive as it gained access to Genesis's proprietary cryptocurrency mining hardware and software and years of experience in mining cryptocurrencies on an industrial scale.

Hive Blockchain Mining Locations



(Source: Elwood research, company data)

However, the relationship soured in 2019, when Genesis launched a proxy war in order to take control of Hive.¹⁶ Tensions first arose between the two firms in September 2018, when Hive asked Genesis to review the electricity pricing for the mining facilities in Iceland and Sweden. As stated in the Master-Service Agreement, Hive is entitled to be charged the same rate as Genesis' cost of power. After increases to the power charges issued to Hive by Genesis, the company demanded full disclosure of these costs, which were not provided by Genesis. As a result, Hive demanded compensation of US\$50m from Hive and for the full costs to be disclosed. Genesis had two representatives on Hive's board and owned 26% of the company's stock. In retaliation, it convened a board meeting on April 19, 2019 to remove Frank Holmes as the interim CEO of Hive, although this effort was unsuccessful. However from April 22, 2019, Genesis shut down Hive's mining facility in Sweden which had 20.4 MW of power mining Ethereum.

On June 28, 2019 Hive announced that they had reached a settlement with Genesis which positively resolved these issues and the mining facility in Sweden had been rebooted¹⁷. As part of the settlement, Hive assumed full responsibility for the management of the mining operations in Sweden and Iceland and later went on to appoint Blockbase Group as the operator. The settlement also limited Genesis to having only one member on Hive's board of directors. During the period when Hive's facility was shut down in Sweden, the Ethereum price increased by 96% and Hive could not effectively profit from this.

¹⁴ Source: Genesis Mining website [\[link\]](#)

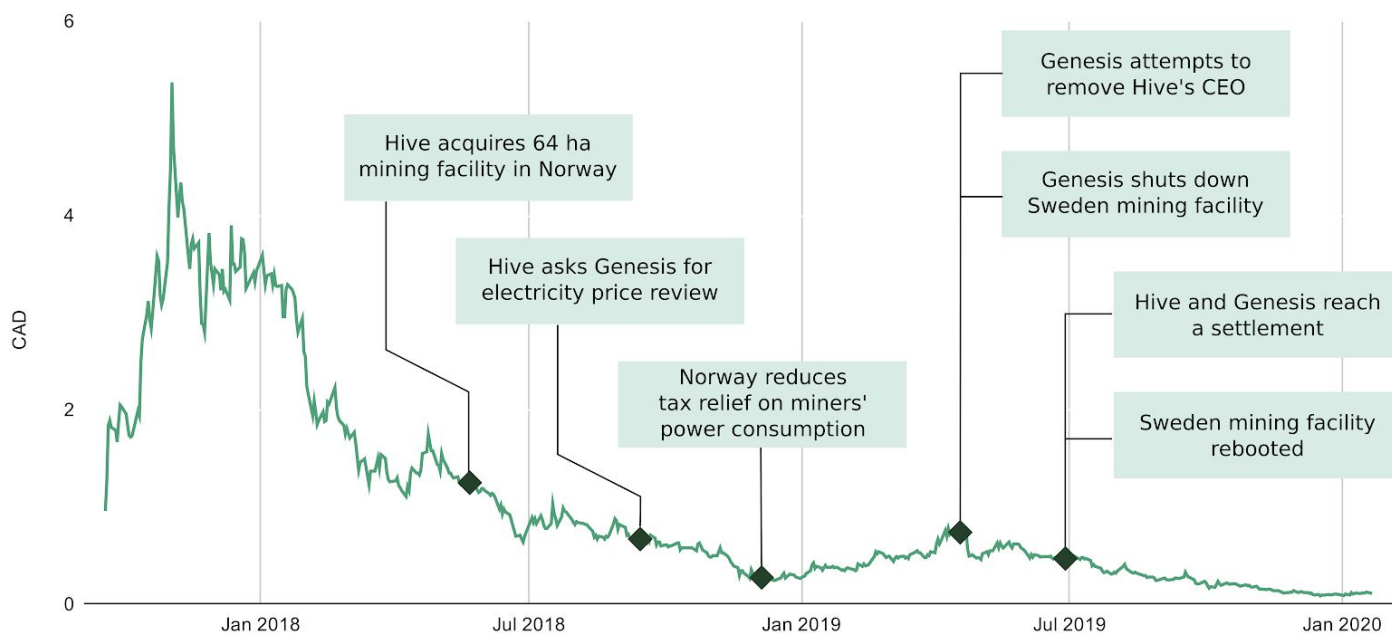
¹⁵ Source: SEDAR [\[link\]](#)

¹⁶ Source: SEDAR [\[link\]](#)

¹⁷ Source: Cision news [\[link\]](#)

Furthermore, in May 2018 Hive acquired a 64-hectare mining facility in Norway which would provide the company with an additional 30 MW of mining capacity for a total cost of \$12.3m. However, in December 2018 the Norwegian Parliament approved a legislative bill determining that cryptocurrency miners would no longer be subject to tax relief on power consumption at the same rate as other power-intensive industries. As a result, the company is still uncertain as to whether they will build out the mining infrastructure at this site or not, resulting in land rights being written off.¹⁸ The chart below shows Hive's share price and the aforementioned events.

Hive Blockchain price and material events



(Source: Elwood research, Bloomberg)

Argo Blockchain Plc

Ticker	Company	Market Cap (US\$m)	Total mining capacity (MW)	Hash rate (PH/s)	H1 2019 Gross mining margin	H1 2019 adj. operating mining margin
ARB LN	Argo Blockchain	26.1	64	581	51%	(6%)

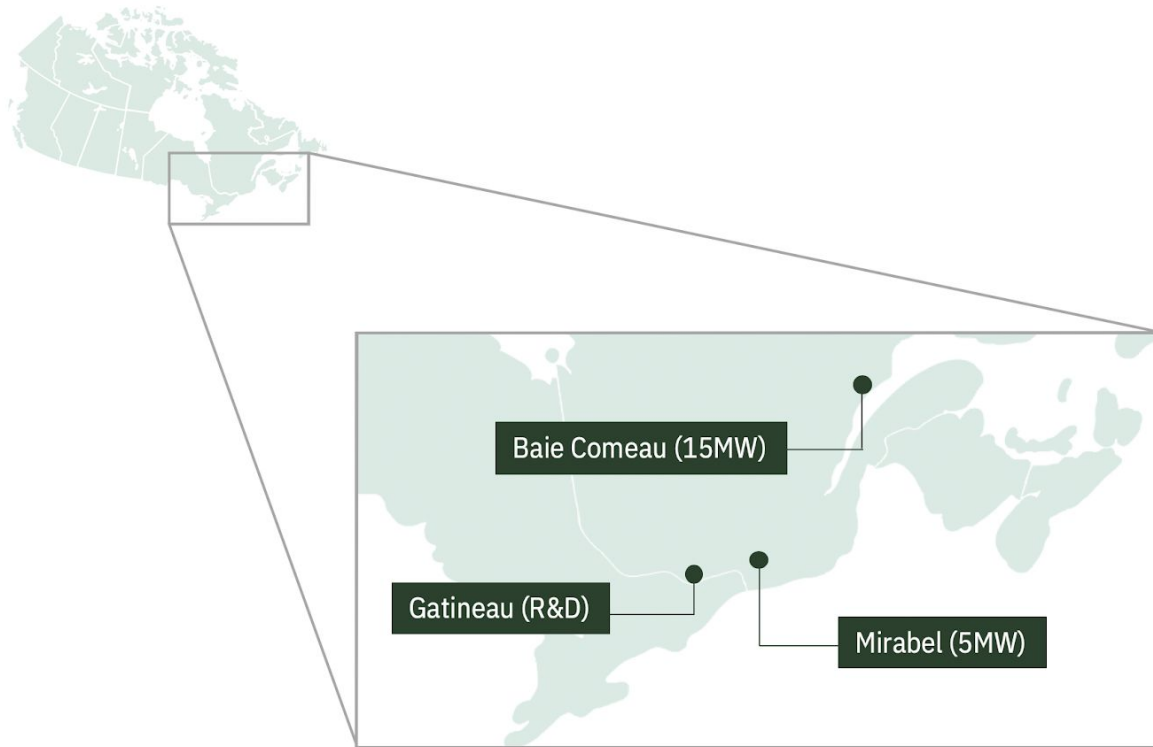
Argo Blockchain is listed on the London Stock Exchange and raised £25m through an IPO on 3rd August 2018 at a valuation of £46.9m, or 12.5p per share.¹⁹ Argo chose London for its credible listing process and regulatory regime and maintains a registered office in London. The firm and nearly all employees are based in Canada. Initially the firm operated a mining-as-a-service business model, where customers would be provided capacity in exchange for a monthly fee. However, the firm pivoted to mining for their own account in Q1 2019.

The company has three facilities in the province of Quebec. The main facility is located in the town of Mirabel, outside of Montreal, with 5MW of mining capacity. The second facility is devoted to research and development, and is located in Gatineau. The third facility is in Baie Comeau, north-east Canada, and as of January 2020 has 15MW of mining capacity.

¹⁸ Source: Hive Blockchain website [\[link\]](#)

¹⁹ Source: Argo Blockchain Prospectus

Argo Blockchain Mining Locations



(Source: Elwood research, company data)

Today the firm has a total of 20MW of operating mining power. GPU.one is a private firm which provides Argo with hosting services, this includes sourcing electricity for Argo and maintaining Argo's mining machines. As the name suggests, GPU.one is predominantly focussed on GPU mining machines, however they host both Argo's ASIC and GPU mining machines.

Initially, Argo's business model was to provide Mining-as-a-service for retail investors. This is an arrangement where Argo owns the mining hardware and investors rent hash power from the firm and earn a share of the mining rewards. At launch in August 2018, Argo initially focussed on mining four cryptocurrencies for their clients with the price cost shown below:²⁰

Argo cryptocurrency mining plans

Plan name	Small	Medium	Large
Plan price per month (\$)	49	99	599
Bitcoin Gold (BTG)	200 H/s	600 H/s	2,800 H/s
Ethereum (ETH)	20 MH/s	600 MH/s	280 MH/s
Ethereum Classic (ETC)	20 MH/s	60 MH/s	280 MH/s
Zcash (ZEC)	200 H/s	600 H/s	2,800 H/s

(Source: Align Research)

²⁰ Source: Align Research initiation note 06/08/2018

All four of these cryptocurrencies can be mined using GPU miners and, at initiation, the company only owned GPU mining machines. However, these cryptocurrencies, and the wider market, depreciated significantly in value throughout 2018, as shown below²¹:

Select cryptocurrency price change throughout 2018 (1 Jan 2018 = 100)



(Source : CoinMarketCap)

As a result of this price depreciation, and the additional expenses required to run a mining-as-a-service business, such as marketing and customer service costs, Argo decided to shut down this service and focus on mining for their own account.

In Q1 2019 Argo began mining for their own account, using their GPU miners to mine Zcash and converting to fiat daily. The firm also purchased S17 and T17 ASIC mining machines from Bitmain in order to start mining Bitcoin. The table below shows how the firm reduced spending cash on building and maintaining their customer-facing website and increased spending on mining equipment as they began to mine for their own account in Q1 2019.

	H1 2018	H2 2018	H1 2019
Additions - website (£)	471,222	200,699	28,335
Additions - computer equipment (£)	442,515	2,365,074	18,056,966

On a recent phone call with management, we were told that Argo sells their cryptocurrency inventory daily and sees itself as a pure infrastructure company. However, this has not always been the case, as this extract from the firm’s 2018 annual report shows:

“Between 11 October 2018 and 14 November 2018, the Group identified an opportunity to make short term gains from low prevailing prices on the Crypto currency market, purchasing Bitcoin and Ethereum to

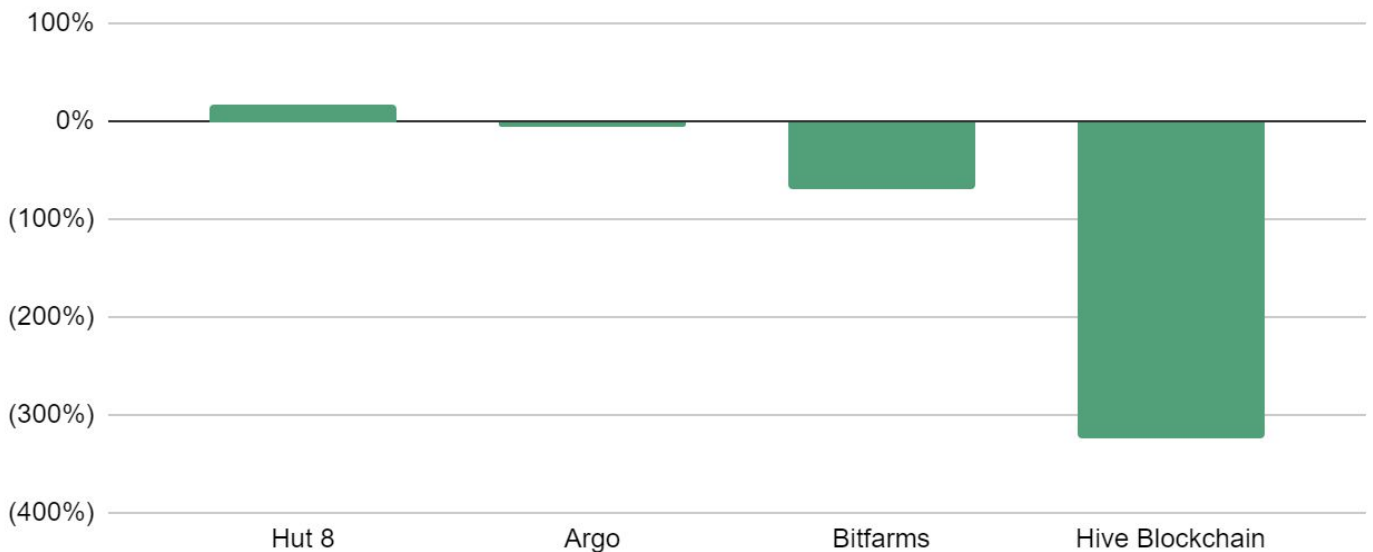
²¹ Source: CoinMarketCap

the value of £329,088. However, due to the continued poor performance of the Crypto currency market, only losses were realised.”²²

Conclusion

Our analysis shows that Hut 8 Mining is the most capital efficient listed cryptocurrency miner during 2019, as it was the only profitable company on our adjusted EBIT basis, and the firm with the highest net income over the period. We have estimated that Hut 8 had a net unit cost of \$4,775 to mine 5,341 Bitcoin over this period. Moreover, Hut 8 is also the largest listed miner, with a hash rate of 952 PH/s.

Cryptocurrency miners return on invested capital (ROIC) analysis (H1 2019, annualised)



(Source: Elwood research, company data)

While there can be considerable returns from investing in mining operations, our analysis suggests that the currently listed companies are placed too high in the mining cost curve, which could put them in a challenging situation given the current volatility of the cryptocurrency market. Miners with a lower position on the cost curve are protected from the volatility, to some extent.

Finally, on valuation terms, while seemingly cheap against major global indices (e.g. S&P 500, MSCI World) on a EV/Sales and EV/EBITDA basis, capital returns have been poor and free cash flow generation has been mostly negative. This, combined with the challenging short-term outlook for the industry, could reduce investor appetite for the sector, which could ultimately undermine valuations, resulting in share price underperformance. However, there are opportunities in this space and strong companies may be able generate surprisingly sustainable earnings, despite price volatility. Identifying these stocks will be challenging and investors will require a highly selective approach.

²² Source: Argo Blockchain website [\[link\]](#)

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