April 4, 2022

BitOoda

The Weekly Hash, 4/4/22

2022 Hashrate Estimates Unchanged, Hash Spreads Expand; Forecast 8X Cost to Mine 1BTC Over Decade

Our current target Hashrate analysis calls for a back-end loaded growth in network Hashrate to 327EH/s by the end of 2022. Our longer-term estimates suggest 1600 EH/s is feasible by the end of the decade *provided BTC price growth supports such expansion.*

Our target Hashrate estimates are unchanged for now. Miners are generally of the view that year-end-2022 Hashrate will end up in the 270-290EH/s range, below our estimate. However, current Hashrate is still tracking above our model. Thus, we view our expectations for large Hashrate growth in 4Q22 on the back of S19XP deliveries and easing power infrastructure constraints as largely intact. ***Thus, no changes to our forecast.***

We currently model Transaction Fee growth over time to become the dominant source of miner revenue by 2028/2029 (slide 3). However, it will require increasing Tx volume growth and network congestion to achieve this.

Daily revenue per PH/s would decline over time, stabilizing post the 2028 halving if Tx fees pick up (slide 4). As a result, a PH/s of mining capacity operating continuously would generate an estimated 0.8BTC in all of 2023 and just 0.12BTC in all of 2030, compared with 4.3BTC in 2020 and 1.4BTC in 2022 (slide 5). Our public companies report this week examined the implications of this "Bitcoin Mining Reserve" for valuation.

Based on this, slide 7 shows the MWh needed and operating cost to produce 1 Bitcoin over time. Assuming $50 per MWh opex, and sustained capex to improve the PH per MW of capacity for the fleet, the operating cost to produce 1 BTC could increase 8x over the 2020-30 period.

Total BTC earnings per PH/s are ~4.52 mBTC, down from last week's ~4.64 mBTC / PH/s (1mBTC or milliBTC = 1/1000 BTC). Transaction Fees gained 63 bps WoW to 1.9% of miner rewards, or 0.12 BTC per block. The "Mempool" shows modest congestion, at 6,730 pending transactions.

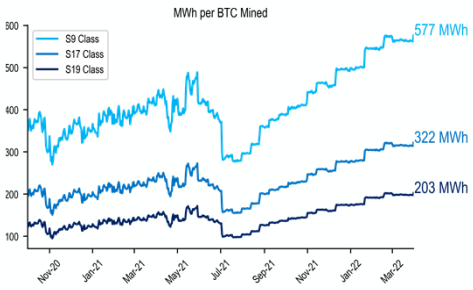
Bitcoin mining revenue rose slightly to $206 / PH/s per day and $225/MWh, as of last night. The block pace is slightly above par in the last 24 hours, at 146, but is 24 blocks behind par roughly a quarter of the way through the current difficulty epoch.

The BitOoda North American Hash Spread™ rose 2.9% from $183 a week ago to $189. We define the BitOoda Hash Spread™ as the difference between the cost of power per MWh and the Bitcoin mining revenue per MWh. This gives miners a quick sense of the surplus generated by their business to cover personnel, overhead, depreciation, and profit. The weighted average around the clock U.S. wholesale industrial power price (5 markets) is $35.40/ MWh We note that many miners have fixed price power purchase agreements at lower levels, so their experienced profitability should be higher.

	S9 Class	S17 Class	S19 Class
Hash Spread	$44	$106	$189
Week on Week	10.0%	4.5%	2.9%

Older-gen S9-class devices saw their BitOoda Hash Spread™ up ~10% to $44/MWh. S17-class devices, the bulk of the installed base, saw a Hash Spread of about $106/ MWh.

It now takes 203 MWh to mine 1 BTC using S19-class rigs, while S17-class machines consume 314 MWh, and S9-class, 563 MWh.



Takeaways

- *Our year-end 2022 target Hashrate of 327 EH/s is unchanged for now*
- *Our model pegs the 2023 and beyond "Bitcoin Mining Reserve" at 2.13BTC per PH/s per day operated continuously through 2030*
- *Based on ongoing capex, we assess the operating cost to produce 1 BTC will grow 8x from 2020 to 2030, to ~$46-50k*

Please see **slide 8** for important disclosures.

Research

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BTC Price (4/4 at 9:30am EDT)	$46,180
Obs Hashrate	207 EH/s

Key Takeaways

- *Our year-end 2022 target Hashrate of 327 EH/s is unchanged for now*
- *Our model pegs the 2023 and beyond "Bitcoin Mining Reserve" at 2.13BTC per PH/s per day operated continuously through 2030*
- *Based on ongoing capex, we assess the operating cost to produce 1 BTC will grow 8x from 2020 to 2030, to ~$46-50k*

Bitcoin Network Rewards
Slowly Tx Fee Centric

- Our projections call for total daily mining rewards to slowly transition toward more Transaction Fee centric rather than Block Reward centric
- However, Tx Fees are currently tracking below our prior estimates
- We assess this is driven by the shift of many exchanges to settling inter-exchange transactions via stablecoins rather than BTC, reducing network congestion and thus fees
- Secondarily, we assess more BTC is held on-exchange in western countries than in Asia, so the shift of trading activity to the west from (especially) China leads to lower on-chain Tx volumes; and – although still early days – the growing adoption of the Lightning Network also reduces on-chain volumes
- **Thus, there may be downside risk to our Tx Fee projections, but current estimates suffice for the present analysis**

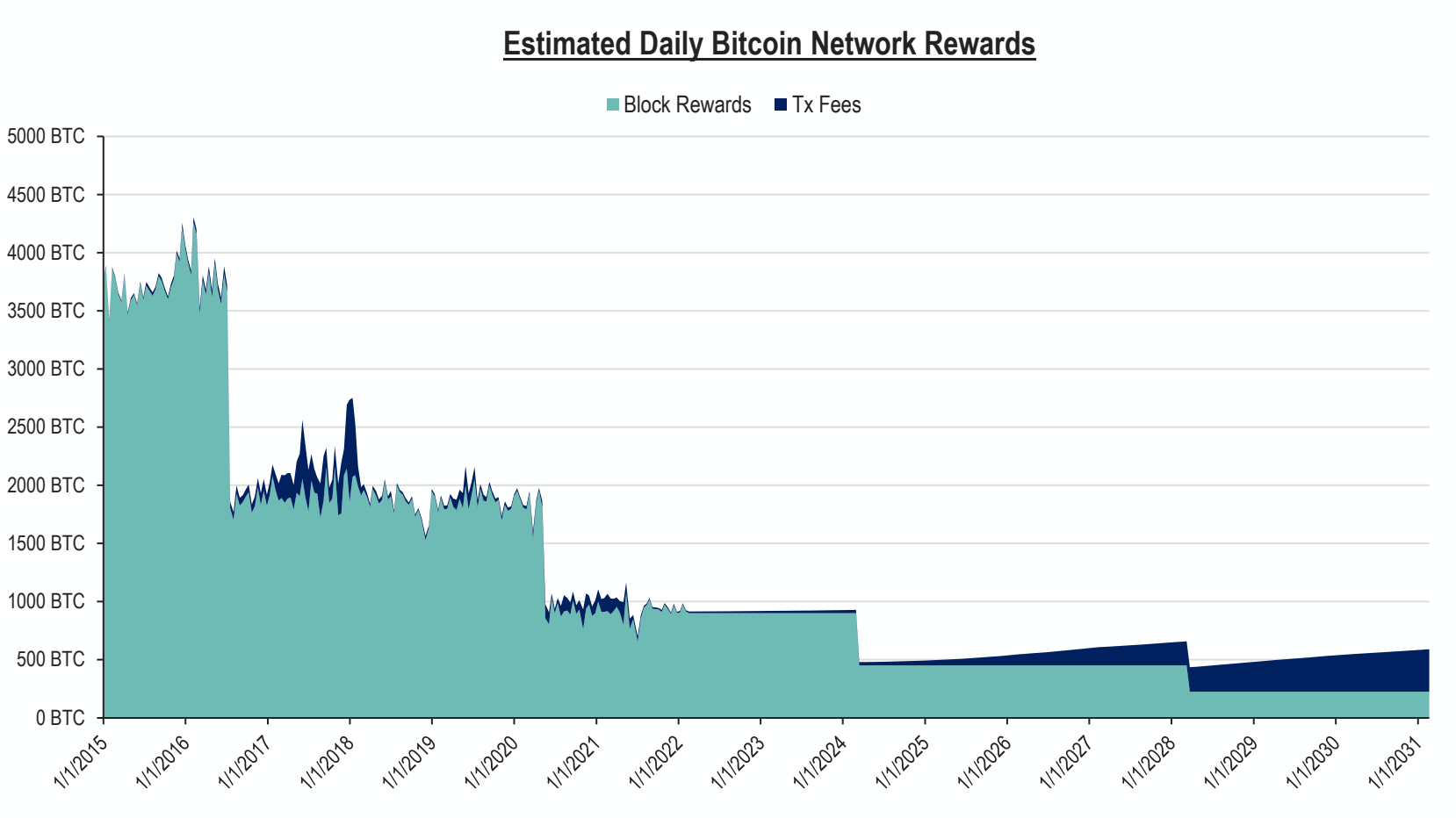


Figure: Historical and Estimated daily rewards to Bitcoin mining network, 1/1/2015 through 2031
Historical as of 4/4/22

Source: BitOoda estimates, CoinMetrics

BTC Revenue per PH/s per Day
Decaying With Rising Hashrate

- We model out the decline in daily revenue per 1PH/s unit of Hashrate as the network expands
- The number stabilizes after the 2028 halving on the assumption that Tx Fees continue to grow and outweigh the further network Hashrate growth
- However, this is predicated on increasing network congestion, which is by no means certain
- **Thus, there may be downside risk to the Tx Fee component of revenue projections**

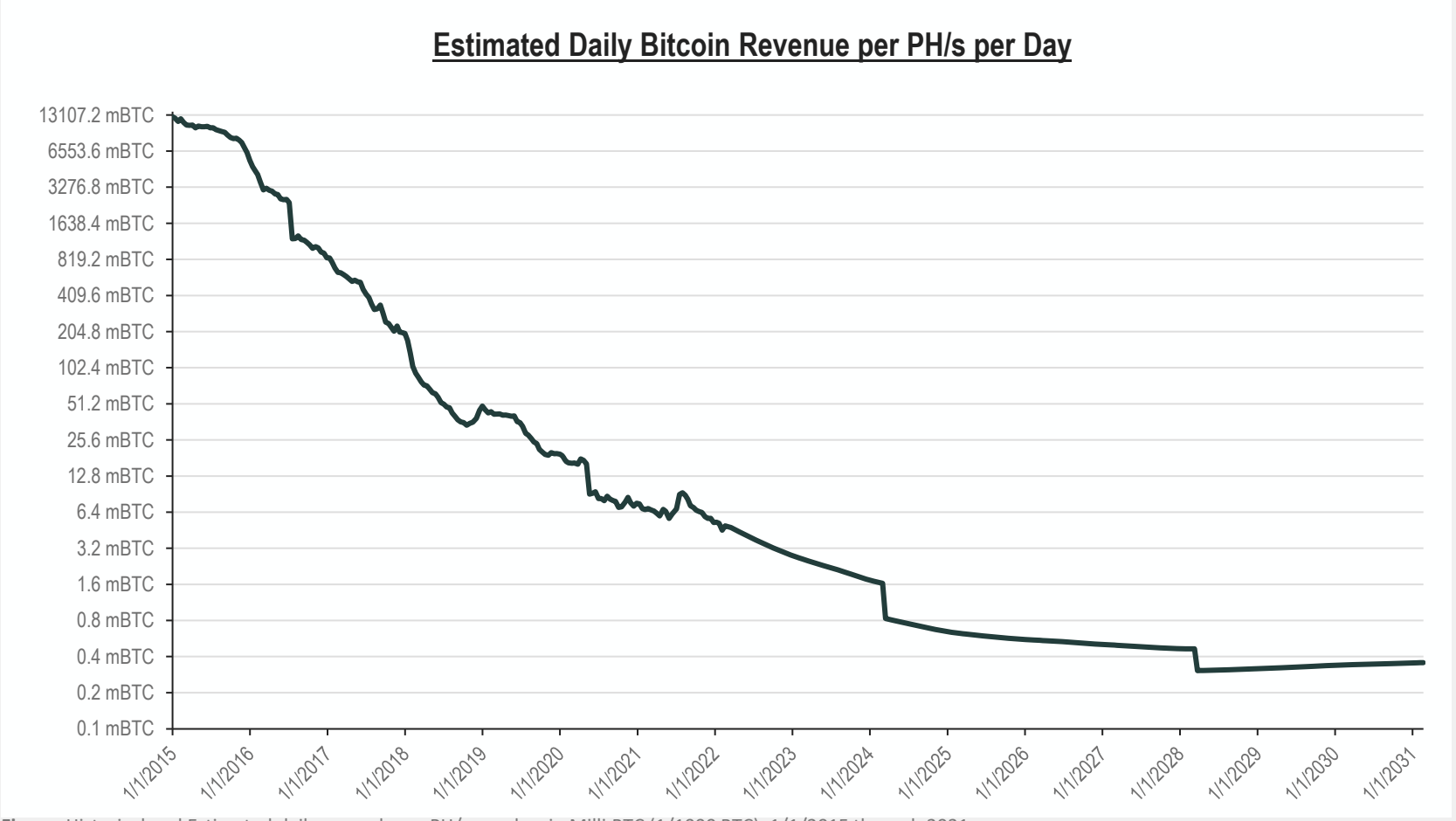


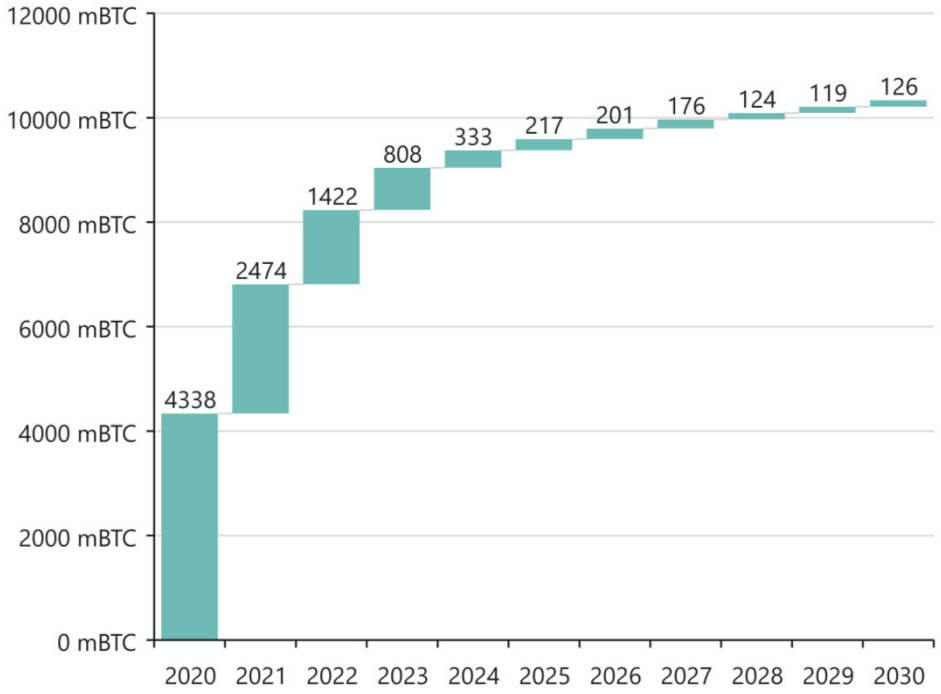
Figure: Historical and Estimated daily rewards per PH/s per day, in Milli BTC (1/1000 BTC), 1/1/2015 through 2031
Historical as of 4/4/22

Source: BitOoda estimates, CoinMetrics

Annual BTC Revenue per PH/s
Declining Rapidly With Rising Hashrate

- The chart below shows our estimate of annual BTC earned per PH/s operating continuously for each full year
- The chart shows that there is a real cost to delaying production: running a PH/s per day for all of 2020 would have earned 4338 milli BTC or 4.3 BTC. The same PH/s running from 1/1/2023 to 12/31/2023 would earn just 808mBTC or 0.8 BTC
- A facility coming online on 1/1/2023 will earn 2.129BTC for every PH/s they operate through 2030 ***assuming no downside to our Tx fee projections***

Total Annual BTC Earned per PH/s per Day, in mBTC



	Total Rewards / PH/s in mBTC
2020	4338
2021	2474
2022	1422
2023	808
2024	333
2025	217
2026	201
2027	176
2028	124
2029	119
2030	126

Figure: Historical and Estimated total annual earnings per PH/s per day, in Milli BTC (1/1000 BTC)
Historical as of 4/4/22

Source: BitOoda estimates, CoinMetrics

Rig Class Assumptions

Driving Hashrate / MW and Revenue per MWh

- We assess the Hashrate per MW could more than triple over the next decade compared to the current S19-class Hashrate per MW
- This is still a slowing rate of improvement, which might prove conservative
- However, our assessment is the actual linewidth and feature shrink will lag behind the nominal process shrink
- We assess die sizes may shrink modestly to enhance yields, resulting in more chips per device
- This does not account for changing design paradigms around direct immersion of hashboards, which may develop sooner than later

Class	Release Date	Hashrate	Power Consumption	Watts/ TH/s	Hashrate / MW
S9	9/1/2016	14 TH/s	1400 W	100.0 W	8.9 PH/s
S17	4/1/2019	50 TH/s	2385 W	47.7 W	18.7 PH/s
S19	5/11/2020	90 TH/s	3100 W	34.4 W	25.9 PH/s
S19XP	8/1/2022	140 TH/s	3010 W	21.5 W	41.5 PH/s
5nm+	10/1/2022	162 TH/s	2919 W	18.0 W	49.7 PH/s
3nm	9/1/2023	188 TH/s	2865 W	15.2 W	58.7 PH/s
2nm	9/1/2026	212 TH/s	2752 W	13.0 W	68.7 PH/s
1nm	9/1/2029	244 TH/s	2757 W	11.3 W	78.9 PH/s

Figure: Chip parameters for key generations

Source: BitOoda estimates, CoinMetrics, Bitmain, MicroBT

Opex per BTC Growing
With Rising Hashrate, Despite Improving Fleet Efficiency

- The charts below show our estimated fleet-wide improvements in the amount of Hashrate generated per BTC, based on our preceding "guesstimate" of improving chip power efficiency
- This leads to a falling MWh needed to run 1 PH/s for a full year
- The preceding analysis leads to an increasing MWh per BTC, because we see declining BTC produced per MWh – with large declines associated with the halving and modest improvements between halvings if Tx Fees continue to tick up
- **Based on a $50 / MWh operating cost, this leads to an 8x increase in operating cost per BTC produced between 2020 and 2030 – *and this needs sustained capex to capture PH/s per MW improvements***

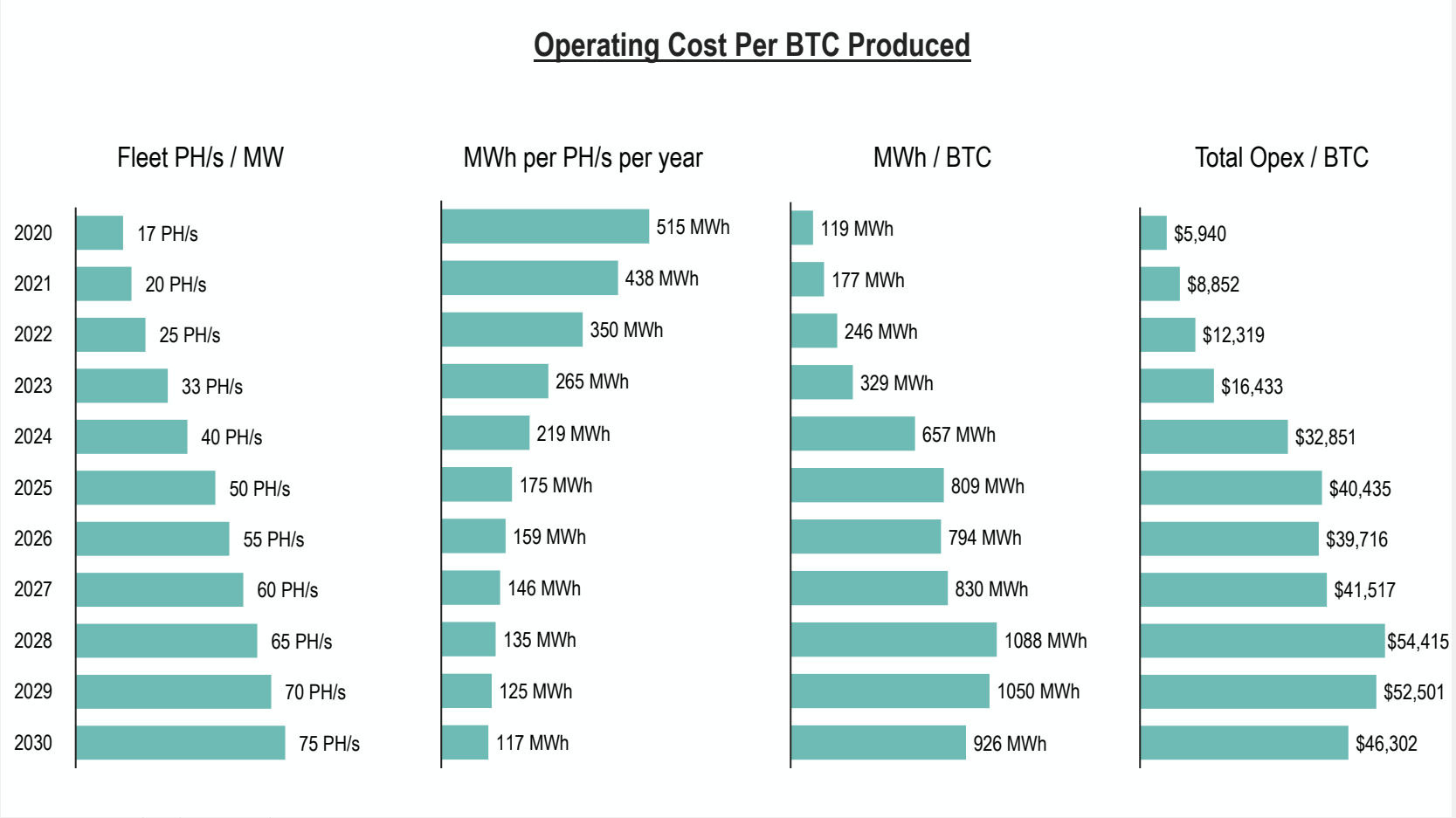


Figure: Historical and Estimated Bitcoin Operating Stats
Assuming $50 / MWh operating costs

Source: BitOoda estimates, CoinMetrics

BitOoda Research

BitOoda Hash™ Dashboard

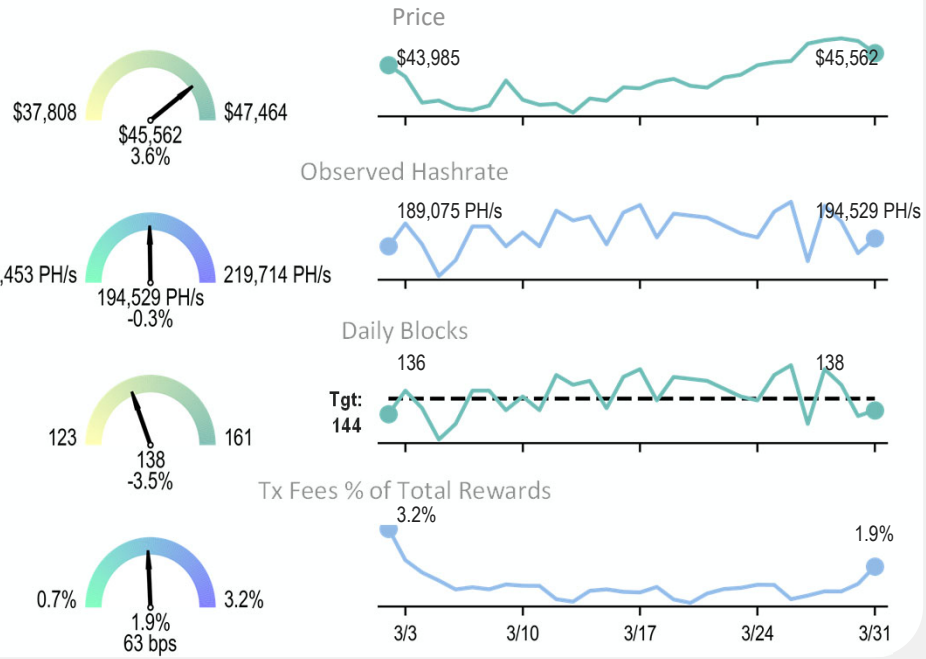
April 4, 2022

Definitions

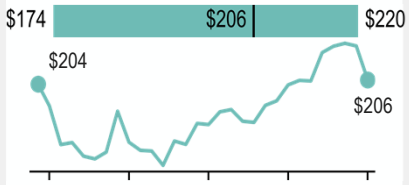
Hash Spread: the difference between the revenue per MWh from mining BTC and the weighted average cost of peak and off-peak power across 8 US zones. It is a quick measure of the profitability of US-based latest-generation mining rigs.

MWh: Megawatt hour
PH/s: Petahash per second
Tx Fees: Fees for BTC transactions

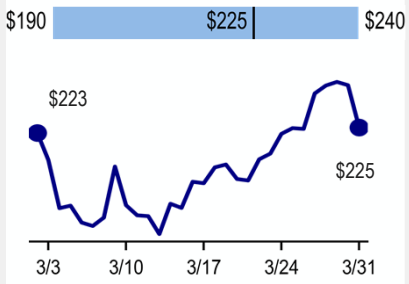
30 Day Range and 7-day % change



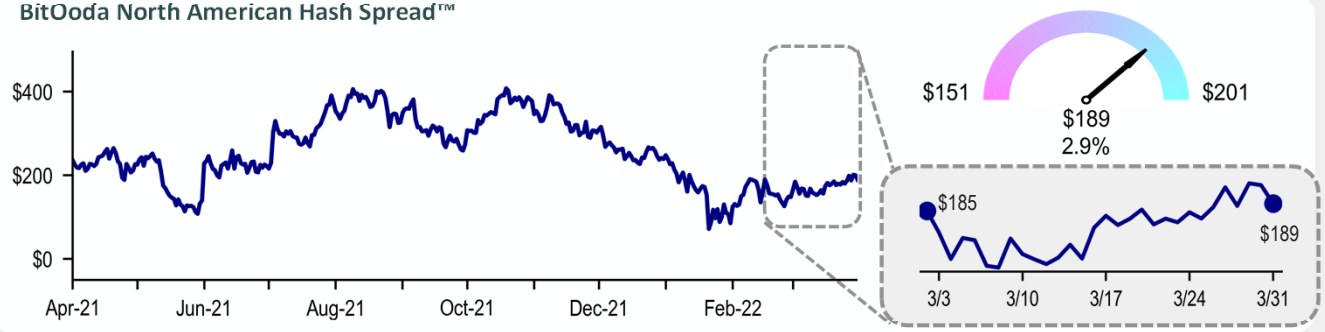
Daily Revenue per PH/s



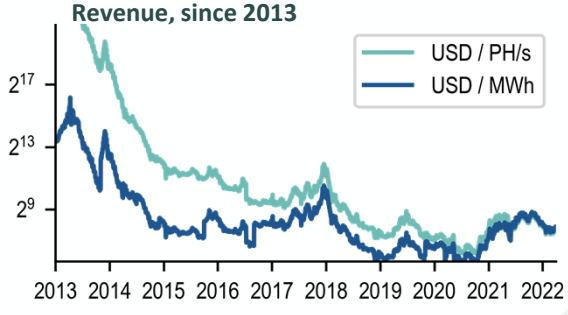
Revenue per MWh (S19 Class)



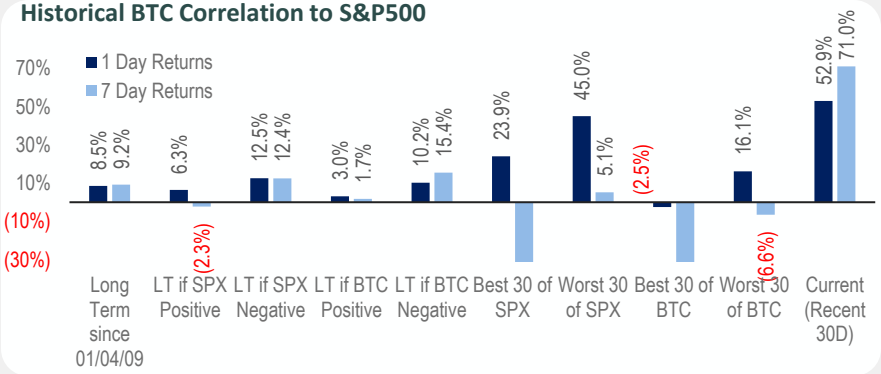
BitOoda North American Hash Spread™



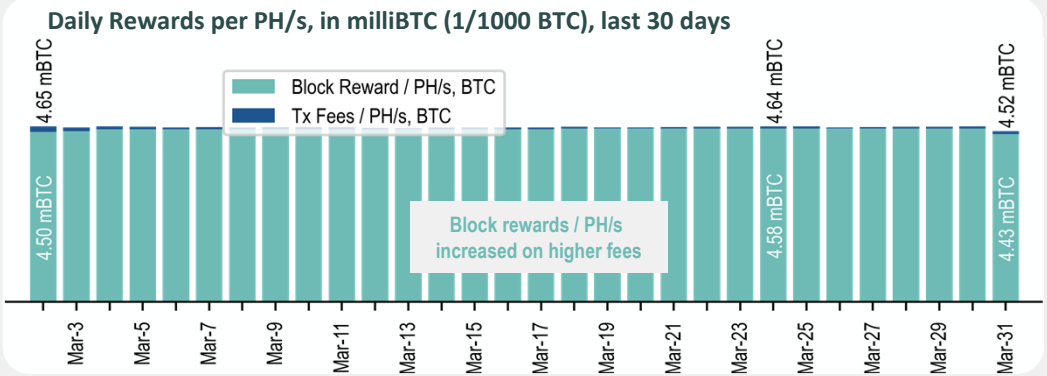
Revenue, since 2013



Historical BTC Correlation to S&P500



Daily Rewards per PH/s, in milliBTC (1/1000 BTC), last 30 days



Source: BitOoda, CoinMetrics, Bloomberg
All data as of prior Midnight UTC except intraday price

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