



2021 Year End Bitcoin Hashpower Estimates: Raising to 198 EH/s; Updating Cost Curve, Mining Costs and Mining Reserve Estimates

A key factor determining investment returns from Bitcoin mining is an estimate of future Hashrate and difficulty. Whether directly investing in Bitcoin mining assets or in mining stocks, this estimate is critical. The mining investment's share of future Hashrate determines future Bitcoin earnings. Our "Bitcoin Reserve" metrics estimate the BTC expected to be mined by 1PH/s (5BTC) and 1MW (171BTC), operating through 2030.

We assess Hashrate could reach 198EH/s by year end 2021, versus our [prior 145 EH/s estimate](#). This is a significant upward revision, as Hashrate lost after China's mining ban has recovered faster than expected.

Long-term Hashrate is price dependent – profitability is a key determinant of both miner balance sheet health and confidence, and investor funding. In this context, we show that the \$353 / PH/s in daily revenue and \$385 / MWh using S19 rigs are both in the 95th percentile of their past two-year history. Mean reversion over time would be a reasonable assumption that needs to be factored into investment models.

Transaction (Tx) fees have proved lower than anticipated recently. We suspect a shift of trading from Asia to the West, coupled with a reduction in overall trading volumes, may be a factor, reducing on-chain transactions. Over time, increased Layer 2 deployment would also lower Layer 1 congestion and thus fees. We are lowering our long-term estimates, with Tx fees not

expected to exceed block rewards until 2028. This estimate also factors into our revenue framework in this report.

We calculate theoretical Bitcoin prices needed to maintain revenue per PH/s at recent levels given our estimate of future Hashrate. At an estimated 198EH/s Hashrate, BTC would need to be \$62k to maintain current profitability, but at \$685k if Hashrate exceeded 1500 EH/s. Conversely, Hashrate could come in under expectations if price is not supportive – Hashrate is a function of price, and we refrain from predicting price, focusing instead on the price that achieves benchmark revenue per PH/s at a given Hashrate.

Current rig pricing of \$80-100 per TH/s could result in 550-900 day payback periods if revenue per PH/s reverted to the \$154 median / \$189 mean. This could pose a risk to the miner ecosystem. We had previously anticipated an inventory glut in the market owing to order cancellations by Chinese miners following the ban. We were wrong. In our view, the global semiconductor shortage allowed rig manufacturers to push out some of their anticipated wafer starts, considering foundries like TSMC / Samsung have no problem filling such freed-up capacity right now. This helped support high rig prices.

We are also updating our estimated Bitcoin network power cost curve, which we assess shifted up with the loss of low-cost Chinese power. However, it should trend back from a

\$40/MWh median now, to \$30/MWh over the next couple of years. This estimate is based on individual miner conversations and is approximate, although the curve's trend and contour are clearer.

We model the MWh needed to produce 1 BTC based on various theoretical power efficiencies (W / TH/s) and the cost to produce 1 BTC, including labor, as well as the incremental cost per BTC for each 1c /kWh (\$10/ MWh) increase in the cost of power. This retrenchment model helps identify when a miner would withdraw capacity based on network Hashrate and equipment efficiency, compared with the prevailing Bitcoin price.

Risks to our Hashrate estimates: upside risk would be driven by easing infrastructure constraints, coupled with a surging price.

Downside risks appear to have substantially played out, driven by China's crackdown.

Takeaways

- *We expect 198H/s Hashrate by year end, with risks skewed to the upside*
- *Median power cost is now estimated at \$40/MWh*
- *While we do not forecast Bitcoin price, we dive into the sensitivity of profitability and payback periods to revenue per PH/s, in turn driven by Transaction fees, BTC price and network Hashrate*
- *Finally, our "Bitcoin Reserve" stands at 5BTC / PH/s and 171BTC/MW through 2030*

Research

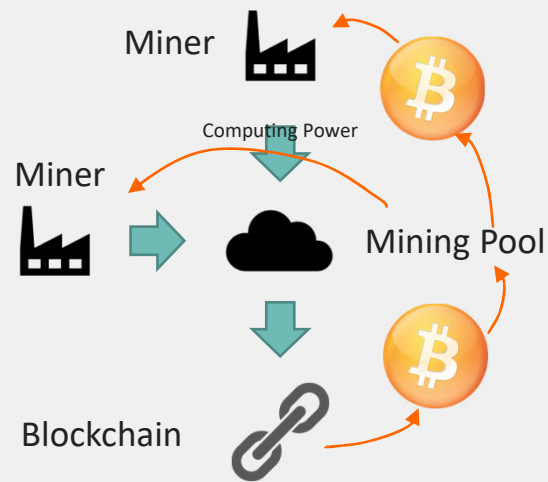
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Key Takeaways

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- *Median power cost is now estimated at \$40/MWh*
- *While we do not forecast Bitcoin price, we dive into the sensitivity of profitability and payback periods to revenue per PH/s, in turn driven by Transaction fees, BTC price and network Hashrate*
- *Finally, our "Bitcoin Reserve" stands at 5TC / PH/s and 171BTC/MW through 2030*
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Hashrate and Mining Economics



- Miners receive rewards as compensation for validating transactions in two forms: (1) each block consists of a number of transactions awaiting validation for a fee, paid by the transactor, and (2) the block includes a reward – currently 6.25BTC per block until mid-2024 – of freshly minted Bitcoin that the protocol generates as an incentive for mining
- Miners contribute their computing power into a mining “pool” to try and solve a brute force puzzle. The first pool to solve the puzzle receives the reward, and the mining pool distributes the total daily rewards (after pool fees) to the different participants in the pool, based on their share of contributed computing power. This pool system helps stabilize cash flows and ensures that even small miners get a fair share of rewards, with less of an impact of luck
- The number of blocks mined each day is targeted at roughly 144, with the complexity of the puzzle changing roughly every 14 days, rising or falling as needed to maintain the 144-block production rate
- In addition, the number of BTC rewards in each block halve every 4 years, the notion being that block rewards are a temporary incentive until time and usage grow transaction fees to the point the network becomes self sufficient
- Thus, the number of Bitcoin minted each day remains roughly the same, halving every 4 years
- **If network computing power or “Hashrate” increased over time, the share of the total daily rewards earned by one unit of mining “Hashpower” would fall**
- **This paper develops a methodology for estimating Hashrate over the lifetime of a mining investment, given that Hashrate is a critical driver of the viability of a mining project**

Revenue Considerations

- Transaction Fees influence total daily BTC mined
- Network growth drives each miner’s share of BTC mined
- Revenue = Bitcoin Price x BTC Volume Mined
- Thus, we need to develop reasonable forecasts around each of these three key variables

Expense Considerations

- The biggest operating expense is power
- Labor and maintenance costs are relatively modest
- Capex is significantly influenced by rig price and availability, which are driven by Bitcoin price and semiconductor shortages
- Decisions such as immersion vs. air cooled and building vs. containerized, as well as existing facility infrastructure, influence timing, investment and payback periods

Hashrate estimates are the most important revenue driver for a mining project, more than price



BitOoda 2021 Hash Estimates

~198 EH/s by Year End

- Our projections call for a target Hashrate of ~198EH/s by year end (YE) 2021
- On July 2nd, we had expected Hashrate to be roughly 145EH/s
- Hashrate recovery following the China ban (loss of ~100 EH/s) has exceeded our expectations, with the target Hashrate currently at 131.7 EH/s
- We continue to expect power infrastructure to be the gating factor in mining expansion

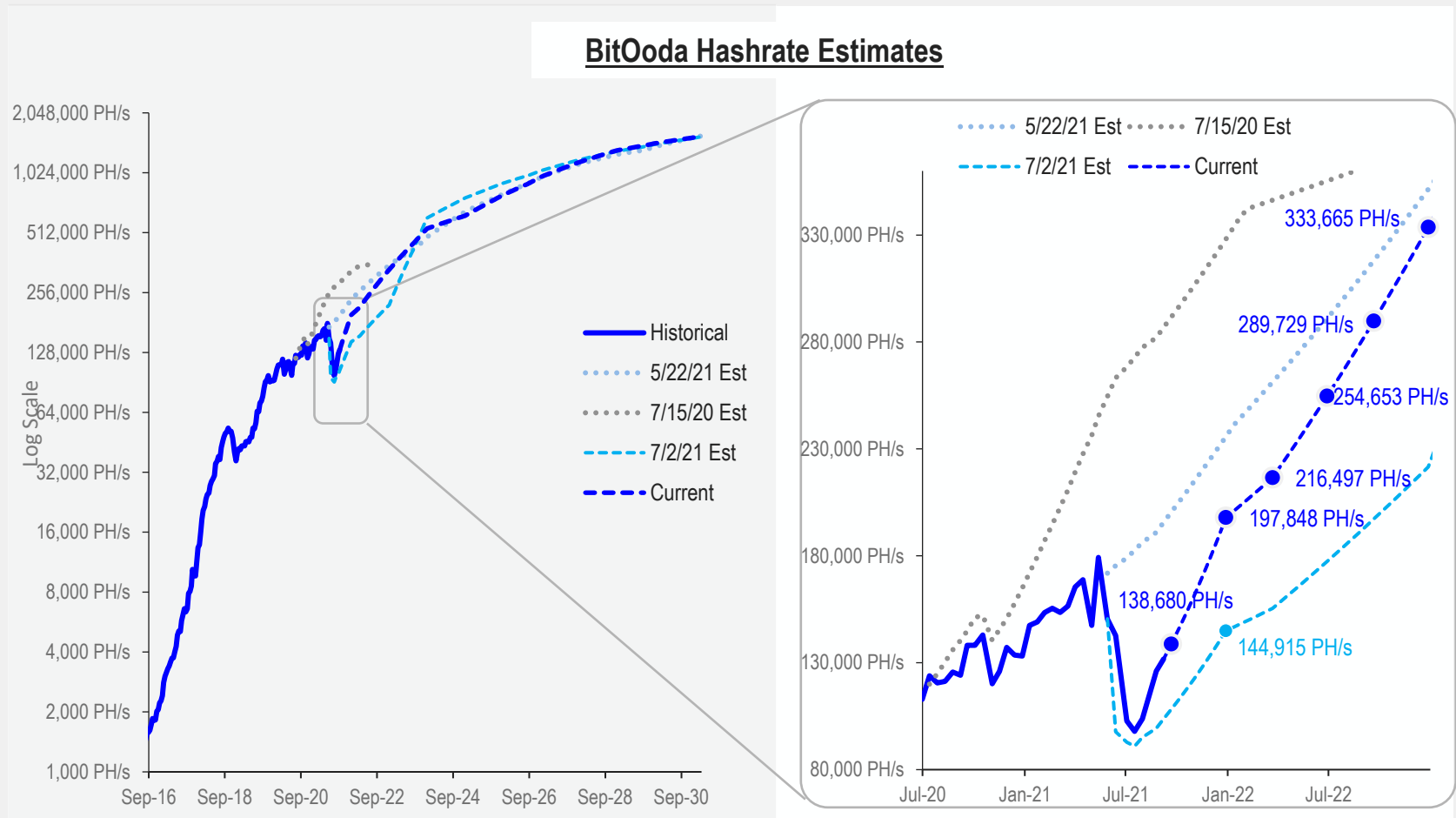


Figure: Historical and Estimated Target Hashrate 2017-2030
 Historical as of 9/7/21; Estimates as of current, 7/2/21, 5/22/21, and 7/15/20

Source: BitOoda estimates, CoinMetrics



USD per PH/s Daily Revenue in USD

- Earnings per PH/s per day are currently \$353, in the 95th percentile compared to the past 2 years
- Over the same period, the mean / median daily earnings have been \$189 and \$154 respectively

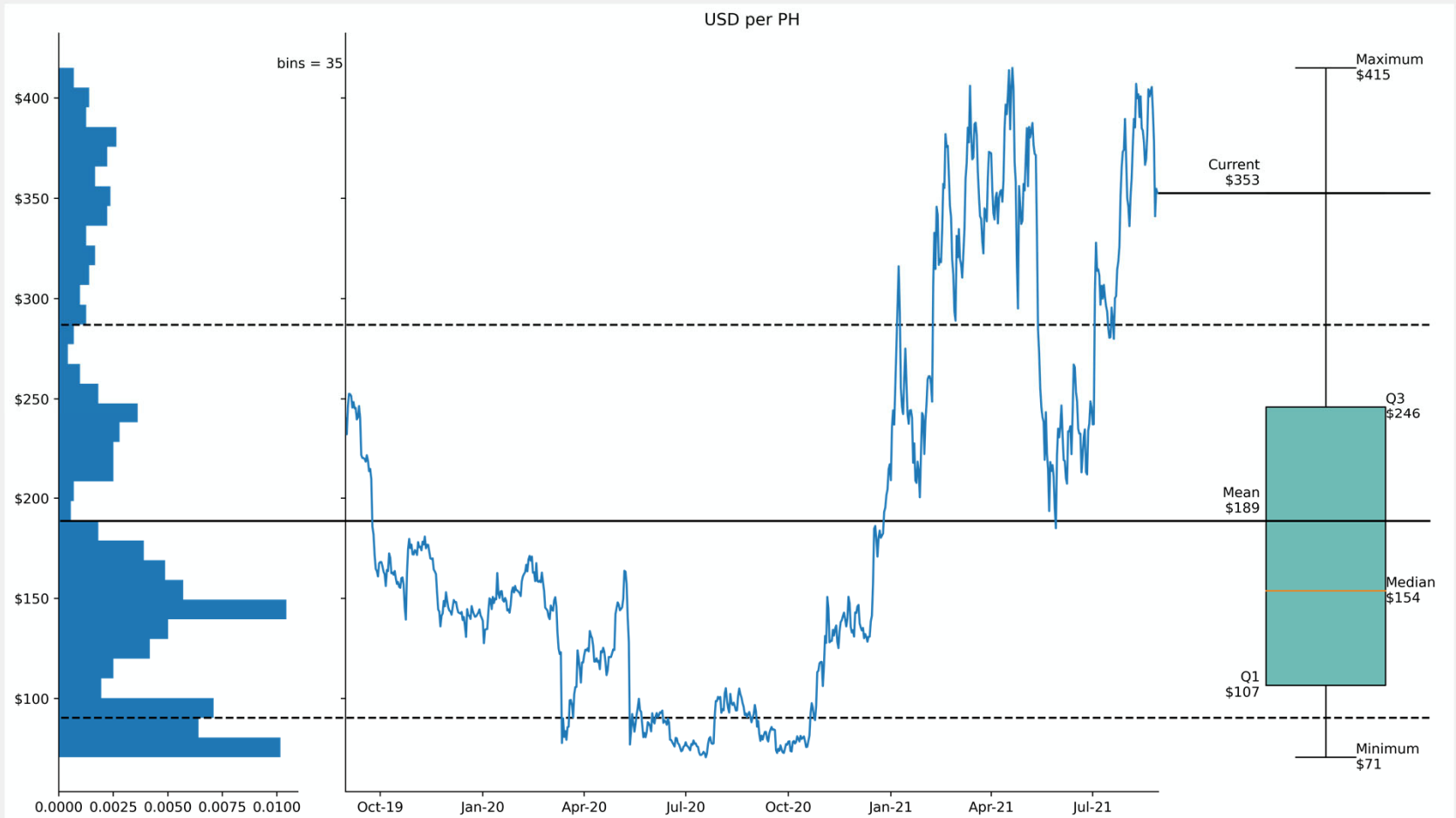


Figure: Bitcoin mining revenue in USD per PH/s over the past two years

Source: BitOoda, CoinMetrics, Bloomberg



USD per MWh Daily Revenue Using Latest Gen Rigs

- Miners using latest-generation S19 class mining rigs are currently earning \$385 per MWh, in the 95th percentile compared to the past 2 years of history
- Over the same period, the mean / median daily earnings have been \$140 and \$99 respectively

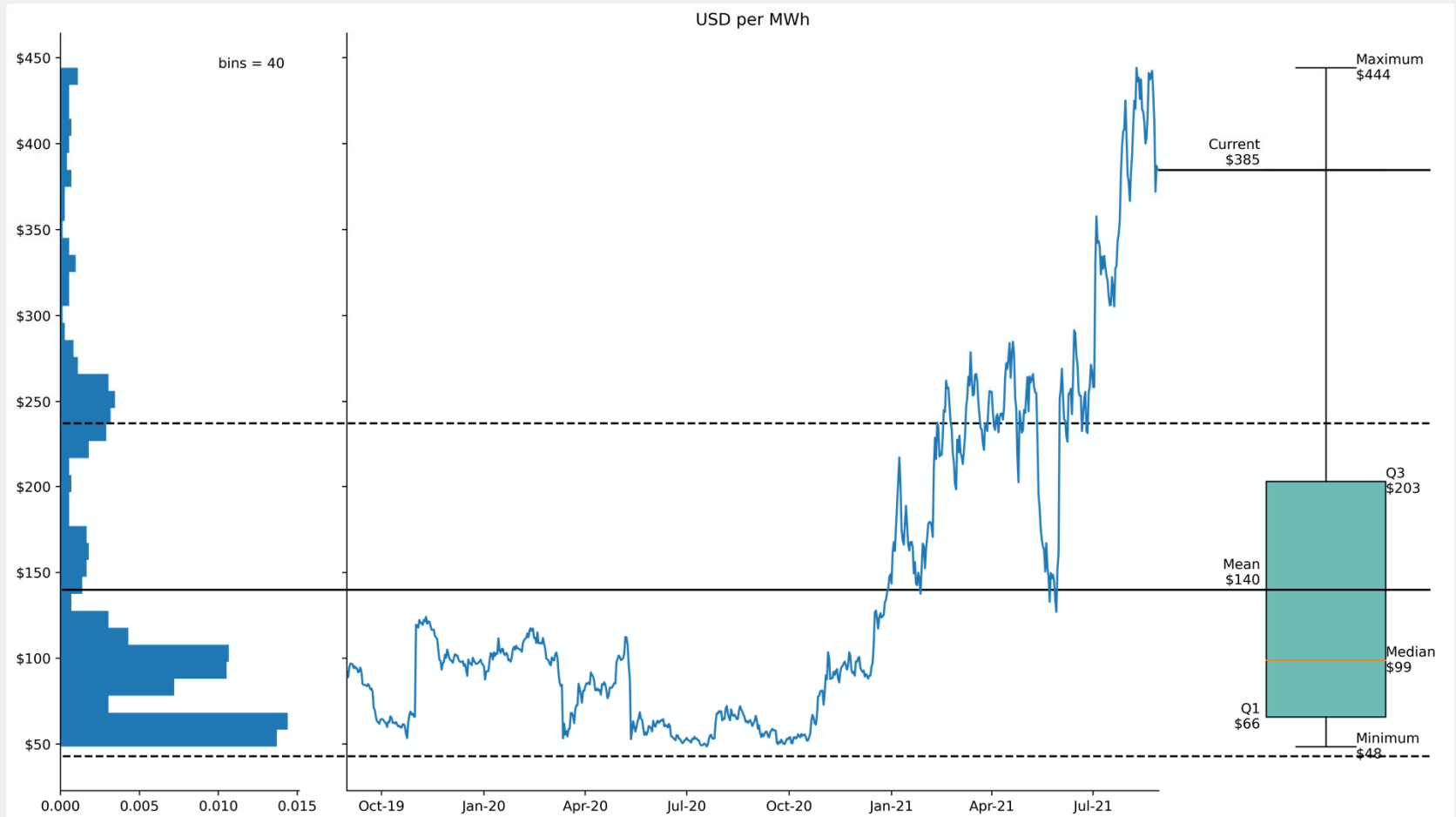


Figure: Bitcoin mining revenue in USD per MWh using then-current gen rigs over the past two years

Source: BitOoda, CoinMetrics, Bloomberg

Mining Revenue Analysis

BTC Earnings / Block Other Driver With Hashrate

- Mining revenue in BTC terms is a function of network payout and network size
- Over time, transactions fees should increase to help offset declining block rewards. The process could be aided by second-order services, such as the Lightning Network, that consolidate lower-value transactions, increasing system throughput while keeping individual transaction fees low
- Our network analysis helps estimate long-term BTC-denominated revenue, factoring in block rewards and Tx fees per PH/s and per MW

- We expect Transaction (Tx) Fees to grow and help offset declining block rewards, crossing over to exceed the block reward post the 2028 halving
- At the same time, we expect the network Hashrate to continue to grow, which will drive a monotonic decline in BTC earned per PH/s
- Tx Fees / block are a function of multiple competing factors:
 - Rising BTC price would inhibit BTC-denominated fee growth
 - High fees inhibit smaller transactions
 - Layer 2 projects, such as the Lightning Network, could consolidate smaller transactions, creating the ability to pay higher fees on the primary Bitcoin blockchain
 - However, if enough transactions migrate to be consolidated on Layer 2 solutions, network congestion on the primary blockchain may ease, lowering fees – particularly in BTC terms

Year	Hashrate	BTC Reward / Block	Tx Fee / Block	Total Bitcoin per Day
2013	8 PH/s	25.00 BTC	0.08 BTC	3612 BTC
2014	291 PH/s	25.00 BTC	0.09 BTC	3613 BTC
2015	743 PH/s	25.00 BTC	0.21 BTC	3630 BTC
2016	2,273 PH/s	12.50 BTC	0.64 BTC	1893 BTC
2017	13.8 EH/s	12.50 BTC	5.92 BTC	2653 BTC
2018	40.2 EH/s	12.50 BTC	0.13 BTC	1819 BTC
2019	92.7 EH/s	12.50 BTC	0.15 BTC	1822 BTC
2020	133.1 EH/s	6.25 BTC	0.77 BTC	1010 BTC
2021	197.8 EH/s	6.25 BTC	0.91 BTC	1032 BTC
2022	334 EH/s	6.25 BTC	1.11 BTC	1059 BTC
2023	537 EH/s	6.25 BTC	1.32 BTC	1090 BTC
2024	623 EH/s	3.13 BTC	1.56 BTC	675 BTC
2025	791 EH/s	3.13 BTC	1.82 BTC	713 BTC
2026	976 EH/s	3.13 BTC	2.13 BTC	757 BTC
2027	1,156 EH/s	3.13 BTC	2.47 BTC	806 BTC
2028	1,326 EH/s	1.56 BTC	2.81 BTC	630 BTC
2029	1,438 EH/s	1.56 BTC	3.18 BTC	682 BTC
2030	1,541 EH/s	1.56 BTC	3.52 BTC	731 BTC

Source: BitOoda estimates, Bloomberg, CoinMetrics



Historical USD / PH/s: Implied Future BTC Prices

- Over the past two years, revenue per PH/s has ranged from \$71 to \$415 per day, as seen in the box plot below left
- Based on our estimated forward network Hashrate and daily BTC mined (including Tx fees), we estimate the price Bitcoin would have to be in order to match the historical economics of mining per PH/s
- On our estimated 198 EH/s by YE 2021, BTC would need to be at \$62,324, and at \$685k by YE 2030, to earn the same \$353 / day a miner earns per PH/s per day today, and ~\$36k and ~\$400k respectively, to match mean earnings of \$189 / PH/s per day

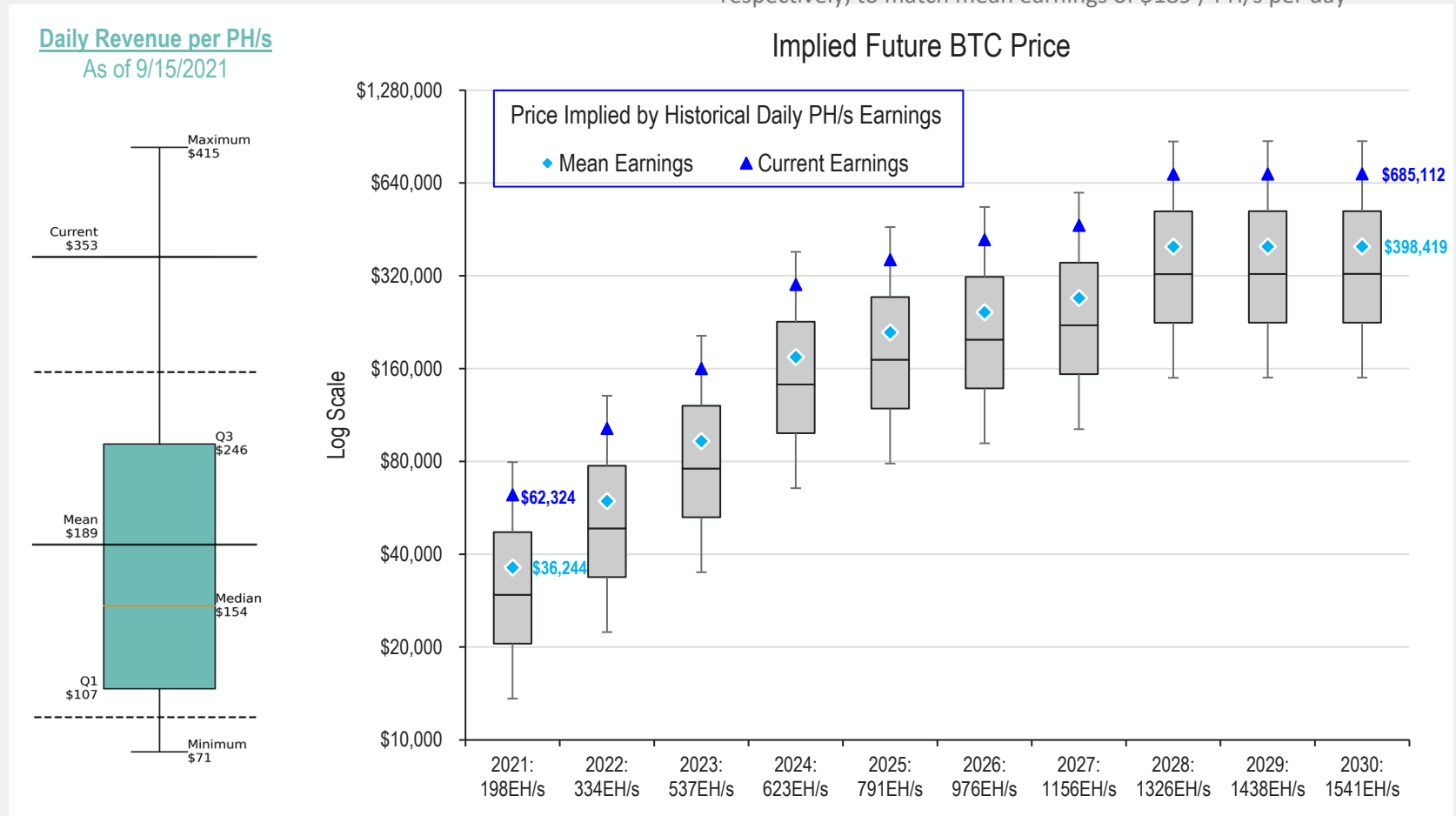


Figure: Implied price range of Bitcoin to match the current range of daily earnings per PH/s, at the higher future network Hashrate

Source: BitOoda, CoinMetrics, Bloomberg

Historical USD / PH/s: Implied Future BTC Prices - Table

- \$71-415 daily revenue / PH/s over the past two years
- As Hashrate increases, BTC flow per PH/s falls
- Price of Bitcoin needs to increase to offset the lower volume, if daily revenue per PH/s is to be comparable with recent history

What would BTC price have to be in order to sustain earnings at levels comparable to recent history at future Hashrates				Daily USD Rev / PH/s, Current Range						
				Minimum	25th Percentile	Median	Mean	75th Percentile	Current	Max
Year End	Hashrate	Daily BTC	BTC / PH/s / Day	\$71	\$107	\$154	\$189	\$246	\$325	\$415
2021	198 EH/s	1031.71	0.0052	\$13,615	\$20,519	\$29,532	\$36,244	\$47,175	\$62,324	\$79,583
2022	334 EH/s	1059.32	0.0032	\$22,364	\$33,703	\$48,507	\$59,531	\$77,485	\$102,368	\$130,717
2023	537 EH/s	1090.40	0.0020	\$34,987	\$52,727	\$75,887	\$93,134	\$121,222	\$160,151	\$204,501
2024	623 EH/s	674.84	0.0011	\$65,539	\$98,771	\$142,156	\$174,464	\$227,080	\$300,004	\$383,082
2025	791 EH/s	712.67	0.0009	\$78,820	\$118,785	\$170,961	\$209,816	\$273,094	\$360,795	\$460,708
2026	976 EH/s	756.88	0.0008	\$91,585	\$138,022	\$198,649	\$243,797	\$317,323	\$419,227	\$535,321
2027	1,156 EH/s	805.68	0.0007	\$101,875	\$153,530	\$220,969	\$271,189	\$352,976	\$466,331	\$595,468
2028	1,326 EH/s	629.92	0.0005	\$149,460	\$225,242	\$324,180	\$397,858	\$517,846	\$684,147	\$873,603
2029	1,438 EH/s	682.33	0.0005	\$149,643	\$225,518	\$324,578	\$398,345	\$518,481	\$684,985	\$874,674
2030	1,541 EH/s	731.19	0.0005	\$149,671	\$225,560	\$324,637	\$398,419	\$518,577	\$685,112	\$874,835

Figure: Implied price range of Bitcoin to match the current range of daily earnings per PH/s, at the higher future network Hashrate

Source: BitOoda, CoinMetrics, Bloomberg





Investment Payback: Days to Recover Capex

- We examine the days needed to recover capex, after power and labor costs
- Investment recovery periods could really stretch out as equipment cost rises
- This is especially a concern if rigs are procured at current prices and revenue per day reverted to the mean / median levels of recent history
- 500-900 day paybacks, excluding infrastructure / container / ancillary capex, could prove prohibitive

Capital Cost / TH/s	Daily USD Rev / PH/s, Current Range						
	Minimum	25th Percentile	Median	Mean	75th Percentile	Current	Max
	\$71	\$107	\$154	\$189	\$246	\$325	\$415
\$10	364 Days	158 Days	91 Days	69 Days	49 Days	36 Days	27 Days
\$20	728	315	181	137	99	71	54
\$30	1092	473	272	206	148	107	81
\$40	1455	630	362	275	198	142	108
\$50	1819	788	453	344	247	178	135
\$60	2183	945	543	412	296	213	162
\$70	2547	1103	634	481	346	249	188
\$80	2911	1260	724	550	395	284	215
\$90	3275	1418	815	619	444	320	242
\$100	3638	1575	905	687	494	355	269
\$110	4002	1733	996	756	543	391	296
\$120	4366	1890	1086	825	593	426	323
\$130	4730	2048	1177	894	642	462	350
\$140	5094	2205	1267	962	691	497	377
\$150	5458	2363	1358	1031	741	533	404

Capex costs of \$80-100 per TH/s could result in prohibitive payback periods if the revenue mean reverts

Figure: Days to recover rig investment as a function of revenue per PH/s per day, assuming \$40/MWh median power cost, PUE of 1.12, and 34W / TH/s efficiency and \$7/MWh labor cost

Source: BitOoda, CoinMetrics, Bloomberg



Power Cost Curve

BitOoda Estimates

\$40/MWh Median Cost

- In July 2020, we published a survey-based cost curve estimate for Bitcoin mining power costs
- Much of the low-cost power was in China and is now shut down, raising the average network power cost by our updated estimates
- However, we expect the curve to shift down and to the right over the next 18-24 months as new capacity seeks the lowest cost
- We estimate the current median power cost at \$40 / MWh, dropping to \$30 / MWh over the next 18-24 months

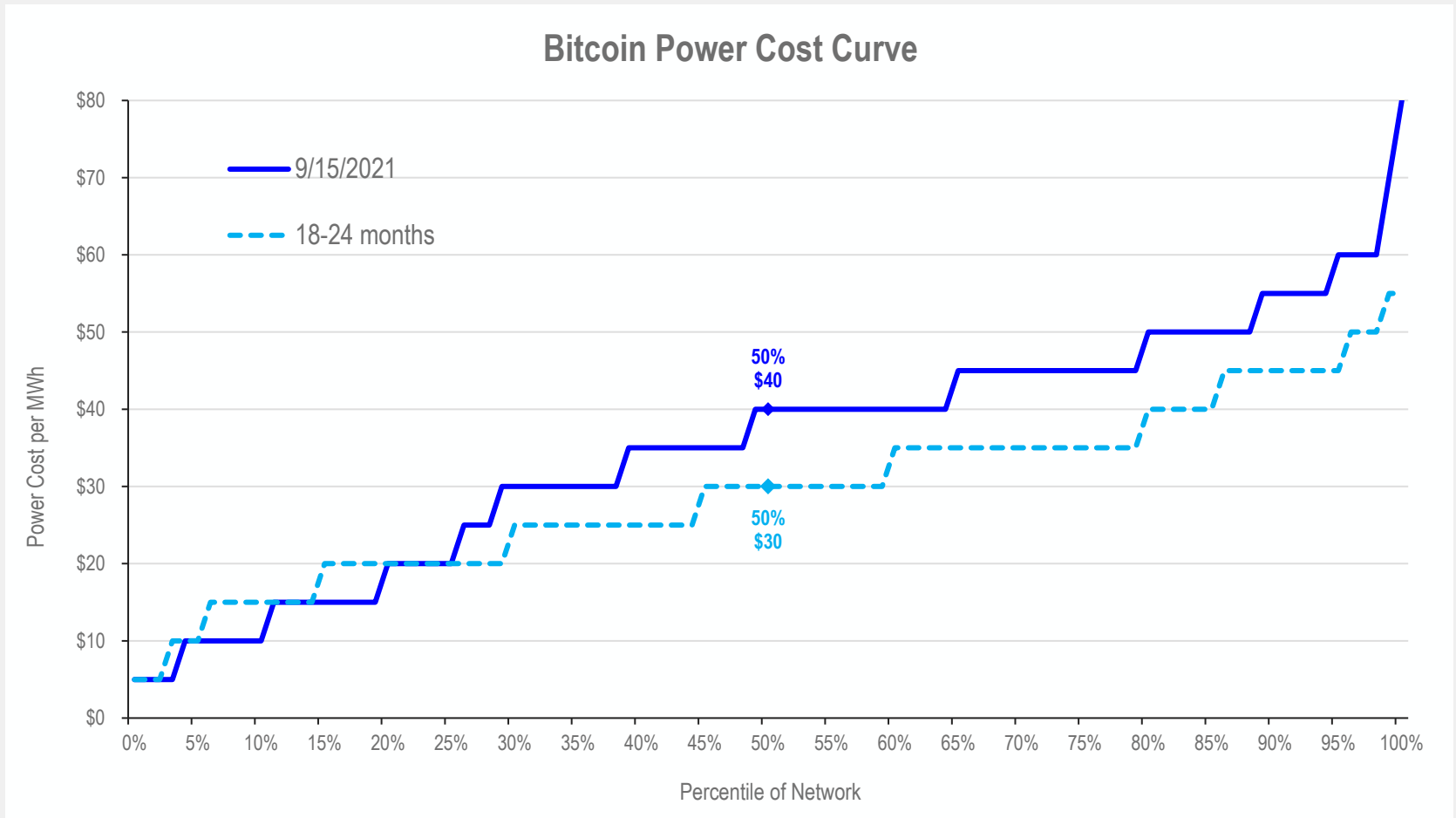


Figure: Power cost curve: Mapping estimated power cost vs. share of network capacity
As of 9/16/2021

Source: BitOoda, CoinMetrics, Bloomberg



MWh per BTC Mined Across Rig Efficiencies

- As Hashrate increases over time, we anticipate it to take an increasing amount of power to produce 1 BTC
- We assess it will take over 500MWh by year end to produce 1 BTC using older S9 class rigs that consume 100W / TH/s
- Later in the decade, it will take over 5000 MWh on S9s, although that is a theoretical notion – the machines would have been turned off long before then

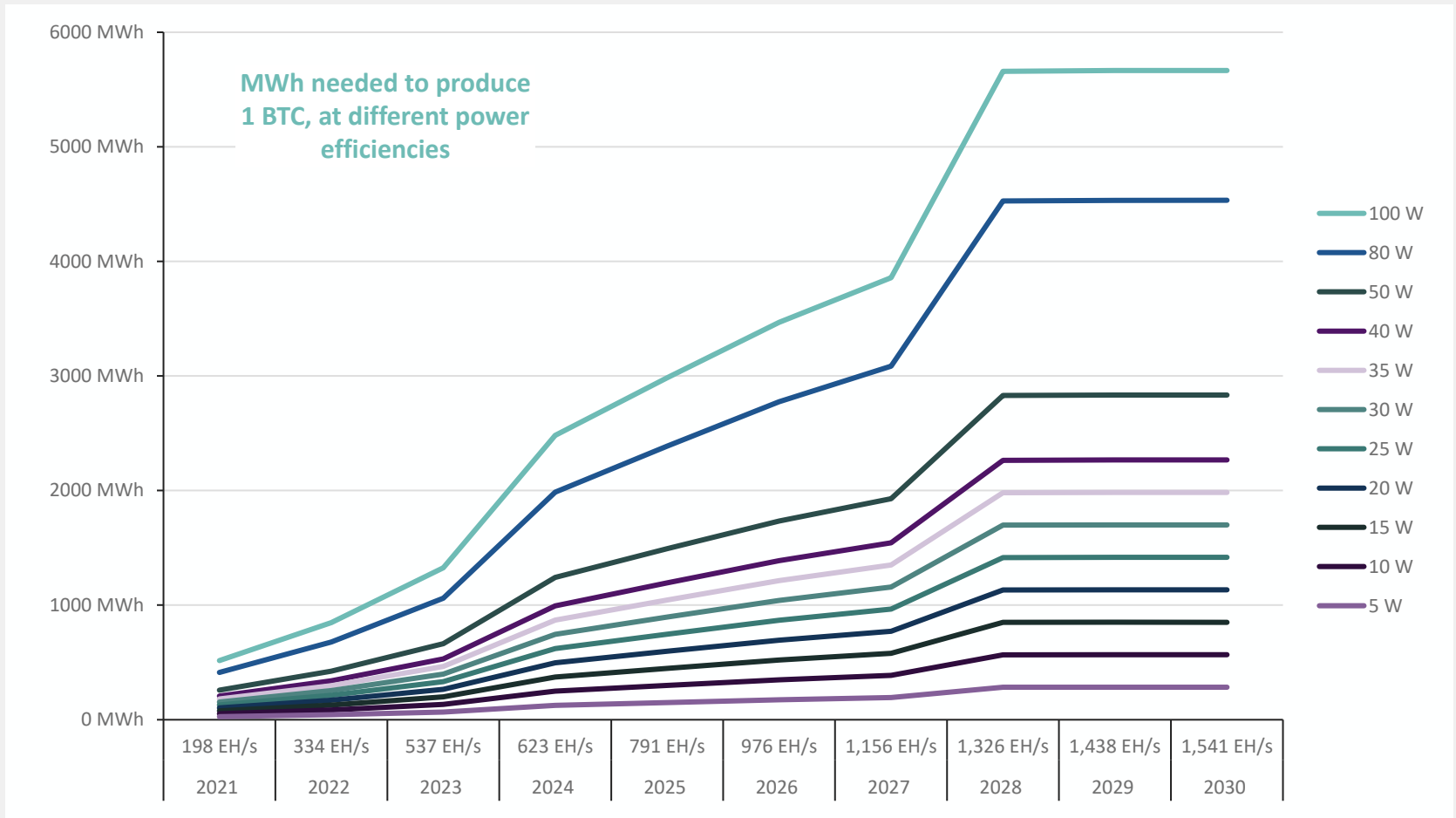


Figure: Power consumption per Bitcoin mined, by theoretical power efficiency, in MWh, based on year-end Hashrate estimates *Source: BitOoda, CoinMetrics, Bloomberg*
 PUE (Power Usage Effectiveness) assumed at 1.12

MWh per BTC Mined Using Latest Gen Rigs

- The price of Bitcoin affects the viability of operating older-gen rigs
- Theoretical efficiencies show the relationship of power consumption to network Hashrate

Power consumption to produce 1 Bitcoin, based on device power efficiency (Watts / TH/s)												
Year End	133 EH/s	100 W	80 W	50 W	40 W	35 W	30 W	25 W	20 W	15 W	10 W	5 W
2021	198 EH/s	515 MWh	412 MWh	258 MWh	206 MWh	180 MWh	155 MWh	129 MWh	103 MWh	77 MWh	52 MWh	26 MWh
2022	334 EH/s	847	677	423	339	296	254	212	169	127	85	42
2023	537 EH/s	1325	1060	662	530	464	397	331	265	199	132	66
2024	623 EH/s	2481	1985	1241	993	868	744	620	496	372	248	124
2025	791 EH/s	2984	2387	1492	1194	1044	895	746	597	448	298	149
2026	976 EH/s	3467	2774	1734	1387	1214	1040	867	693	520	347	173
2027	1,156 EH/s	3857	3086	1928	1543	1350	1157	964	771	579	386	193
2028	1,326 EH/s	5658	4527	2829	2263	1980	1698	1415	1132	849	566	283
2029	1,438 EH/s	5665	4532	2833	2266	1983	1700	1416	1133	850	567	283
2030	1,541 EH/s	5666	4533	2833	2267	1983	1700	1417	1133	850	567	283

Figure: Power consumption per Bitcoin mined, by theoretical power efficiency, in MWh PUE (Power Usage Effectiveness) assumed at 1.12

Source: BitOoda, CoinMetrics, Bloomberg



Cost to Mine 1 BTC Using 100W / TH/s Rigs

- By YE 2021, it should take \$3,600 in labor and \$5,155 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 100W machines would be $\$3608 + 5155 \times 2 = \$13,918$
- By YE 2024, the same miner would spend \$66,995 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$66,995)

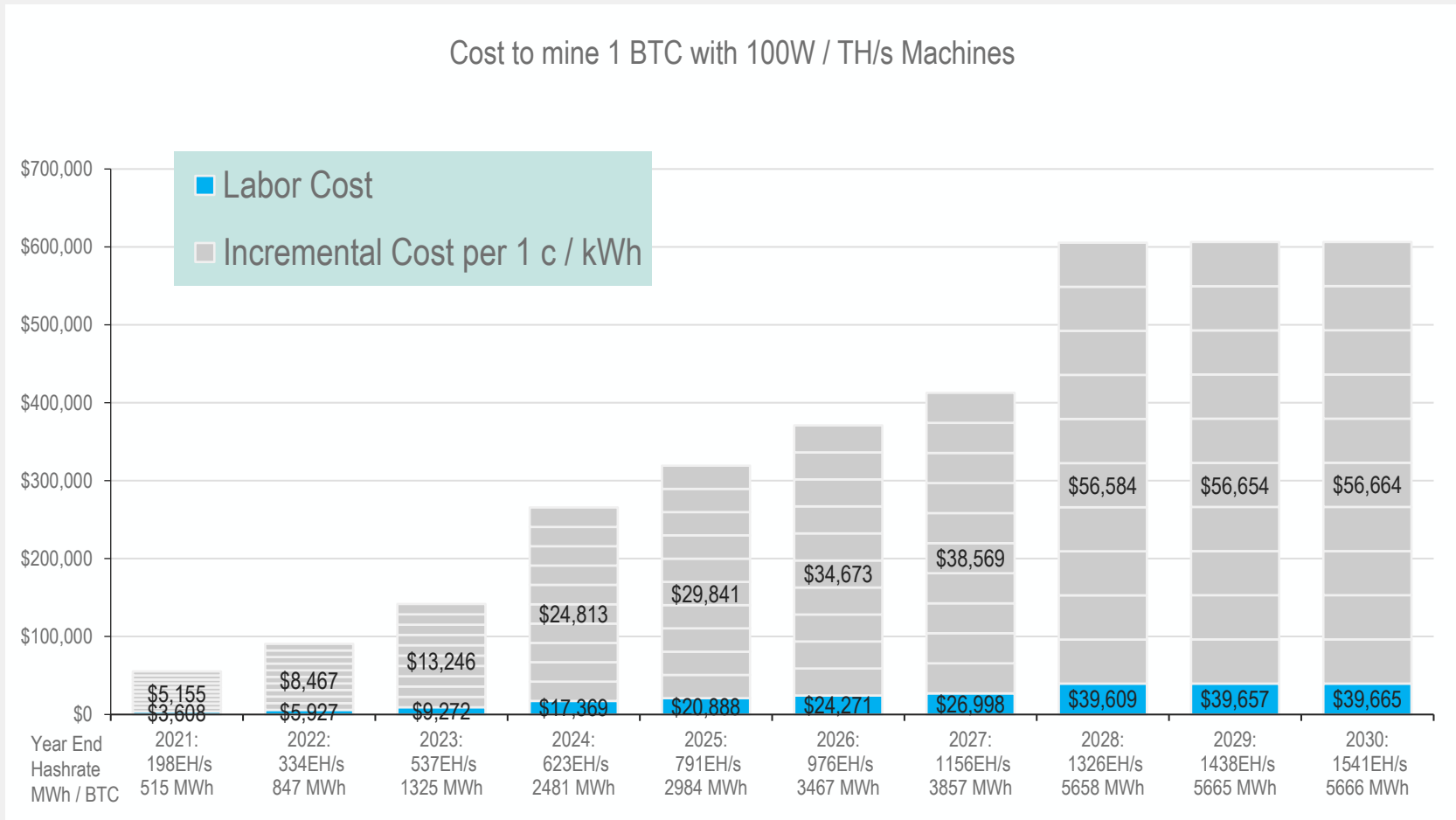


Figure: Cost to mine 1 Bitcoin using a 100 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg



Cost to Mine 1 BTC Using 80W / TH/s Rigs

- By YE 2021, it should take \$2,887 in labor and \$4,124 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 80W machines would be \$2,887 + 4,124 x 2 = \$11,135
- By YE 2024, the same miner would spend \$53,595 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$53,595)

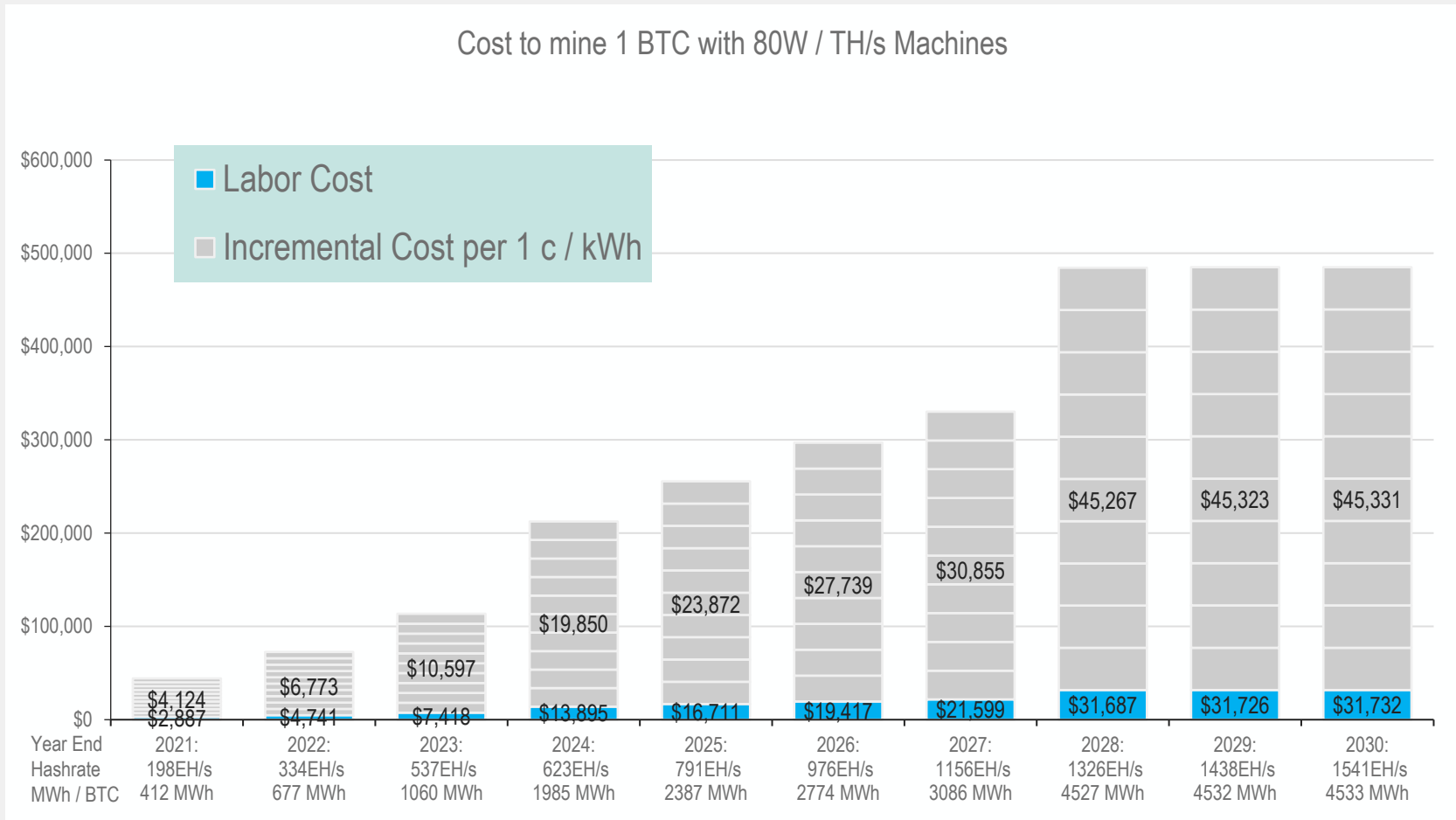


Figure: Cost to mine 1 Bitcoin using a 80 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg



Cost to Mine 1 BTC Using 50W / TH/s Rigs

- By YE 2021, it should take \$1,804 in labor and \$2,577 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 50W machines would be $\$1,804 + 2,577 \times 2 = \$6,958$
- By YE 2024, the same miner would spend \$33,496 on this older equipment, assuming Bitcoin price is higher than that (i.e.. \$33,496)

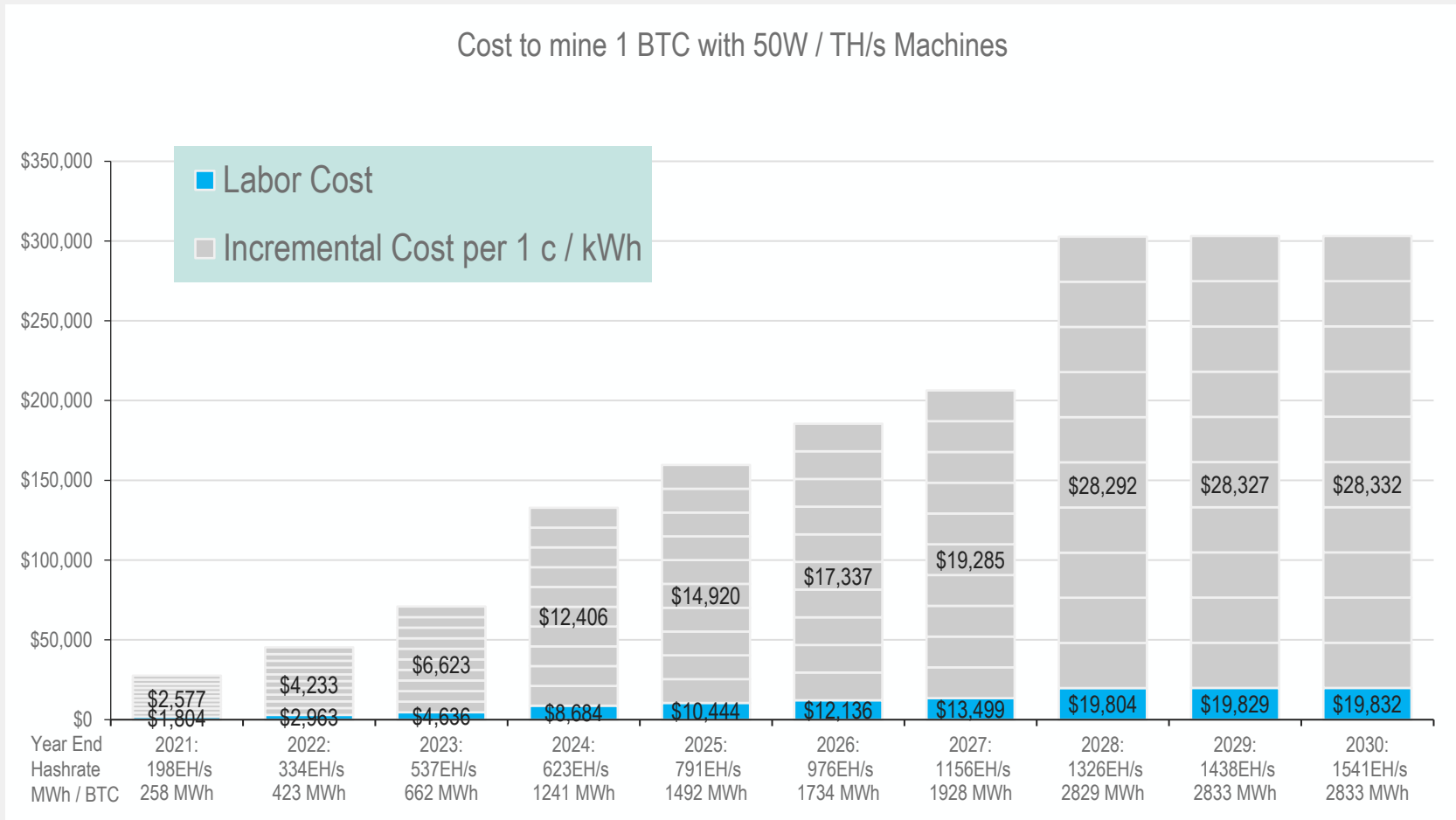


Figure: Cost to mine 1 Bitcoin using a 50 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg



Cost to Mine 1 BTC Using 40W / TH/s Rigs

- By YE 2021, it should take \$1,443 in labor and \$2,062 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 40W machines would be \$1,443+ 2,062 x 2 = \$5,567
- By YE 2024, the same miner would spend \$26,798 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$26,798)

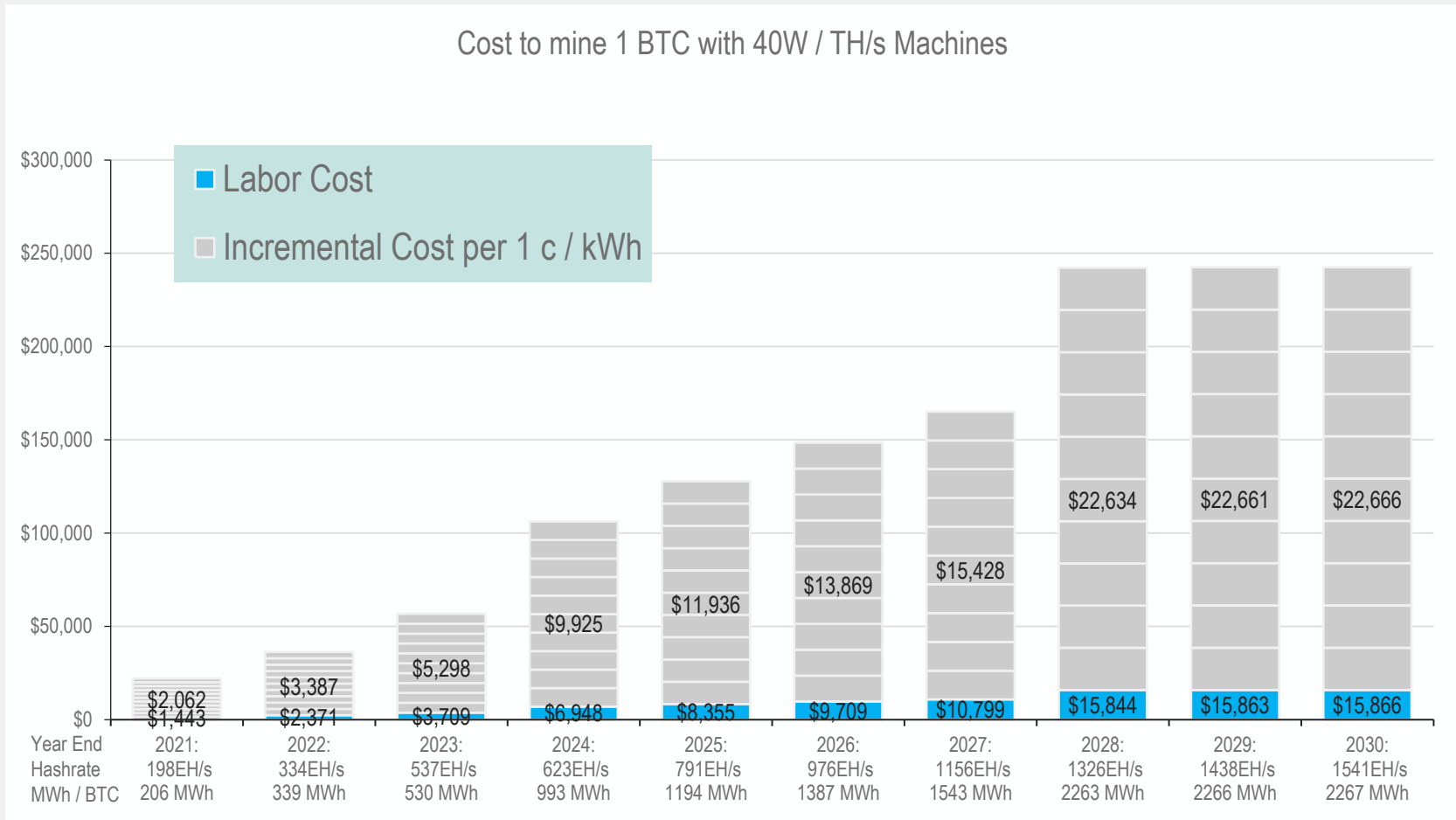


Figure: Cost to mine 1 Bitcoin using a 40 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg

Cost to Mine 1 BTC Using 35W / TH/s Rigs

- By YE 2021, it should take \$1,263 in labor and \$1,804 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 35W machines would be \$1,263+ 1,804 x 2 = \$4,871
- By YE 2024, the same miner would spend \$23,447 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$23,447)

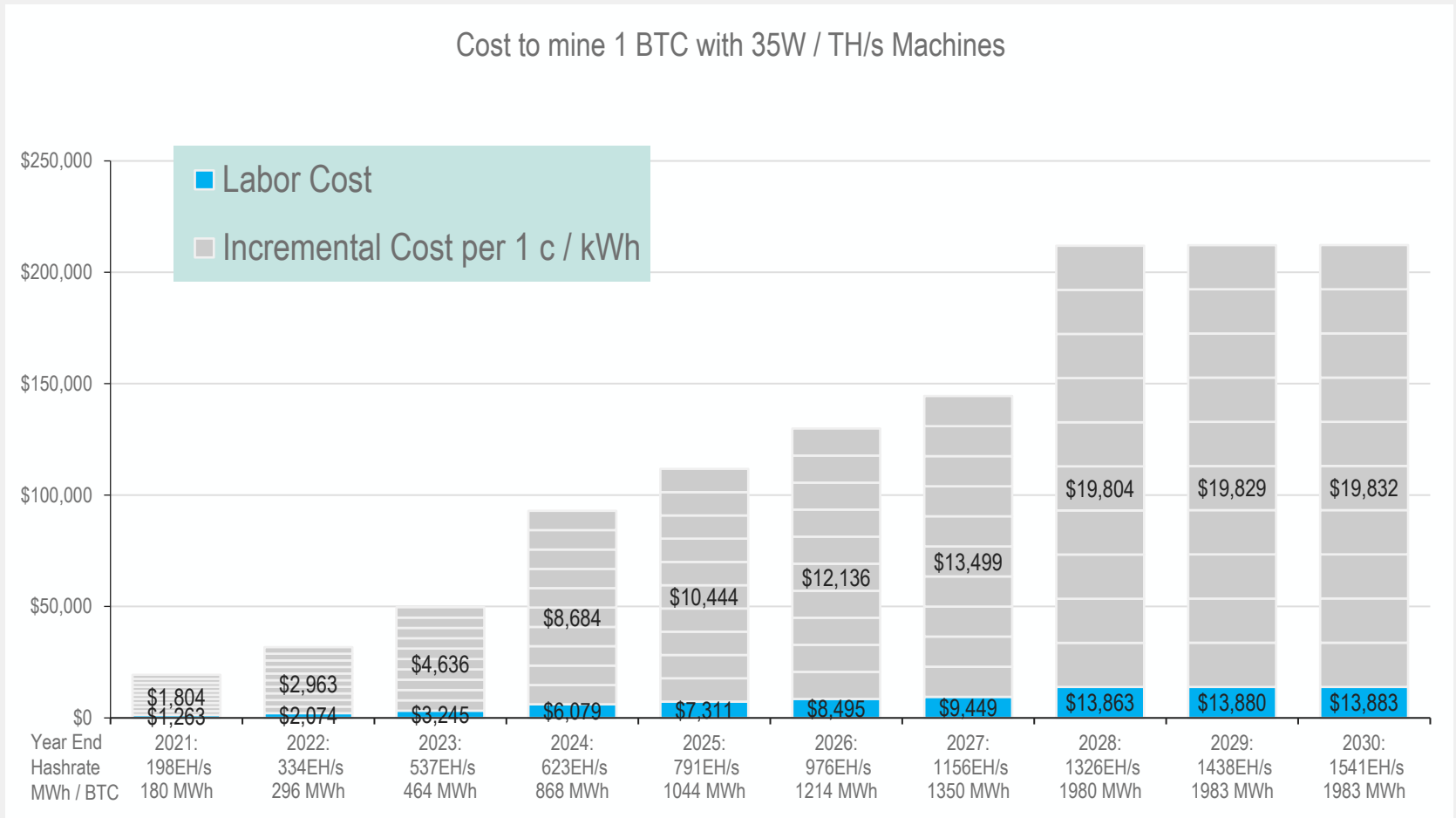


Figure: Cost to mine 1 Bitcoin using a 35 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg

Cost to Mine 1 BTC Using 30W / TH/s Rigs

- By YE 2021, it should take \$1,082 in labor and \$1,546 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 30W machines would be $\$1,082 + 1,546 \times 2 = \$4,871$
- By YE 2024, the same miner would spend \$20,099 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$20,099)

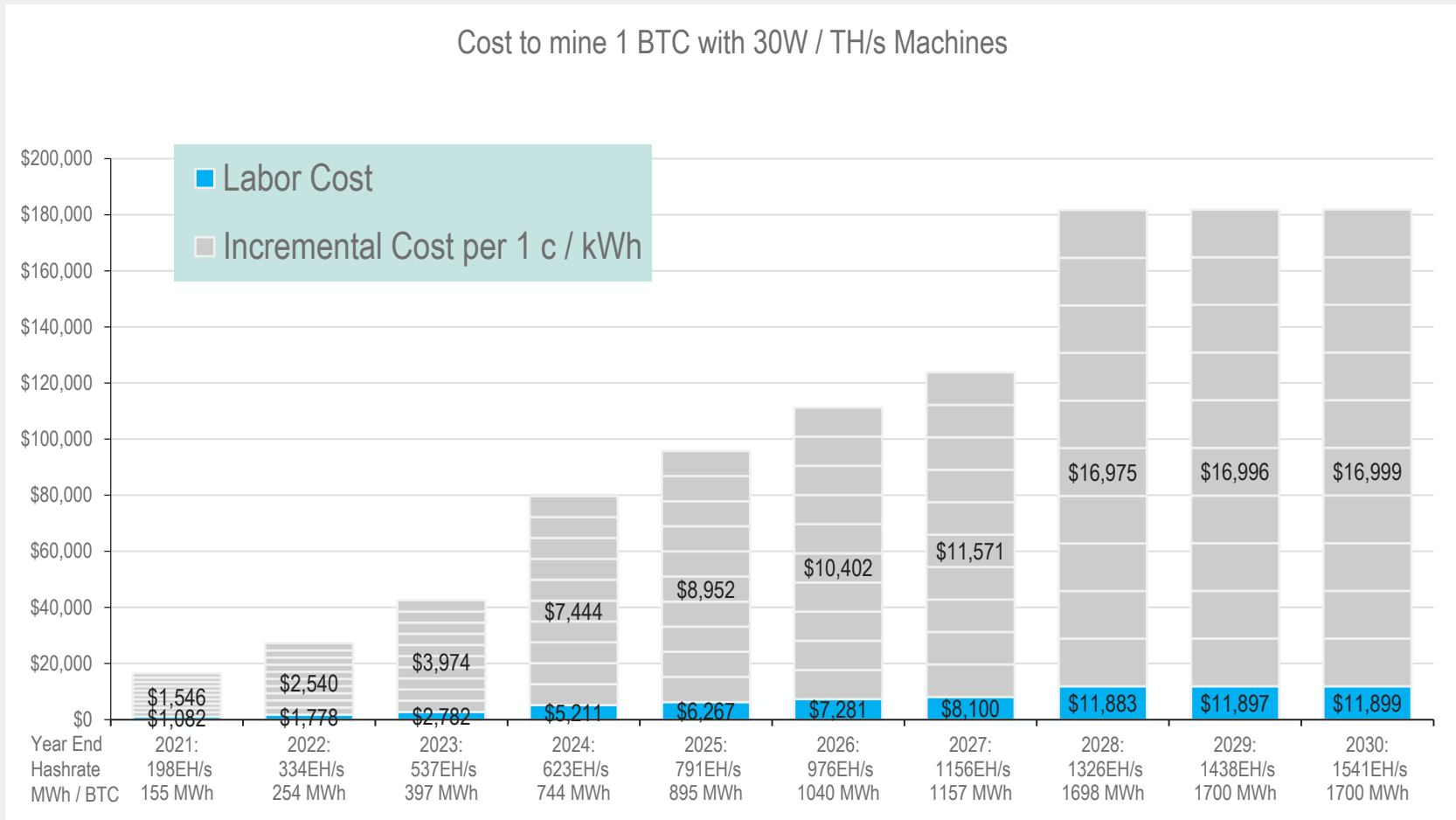


Figure: Cost to mine 1 Bitcoin using a 30 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg



Cost to Mine 1 BTC Using 25W / TH/s Rigs

- By YE 2021, it should take \$902 in labor and \$1,289 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 25W machines would be $\$902 + 1,289 \times 2 = \$3,480$
- By YE 2024 end, the same miner would spend \$16,748 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$16,748)

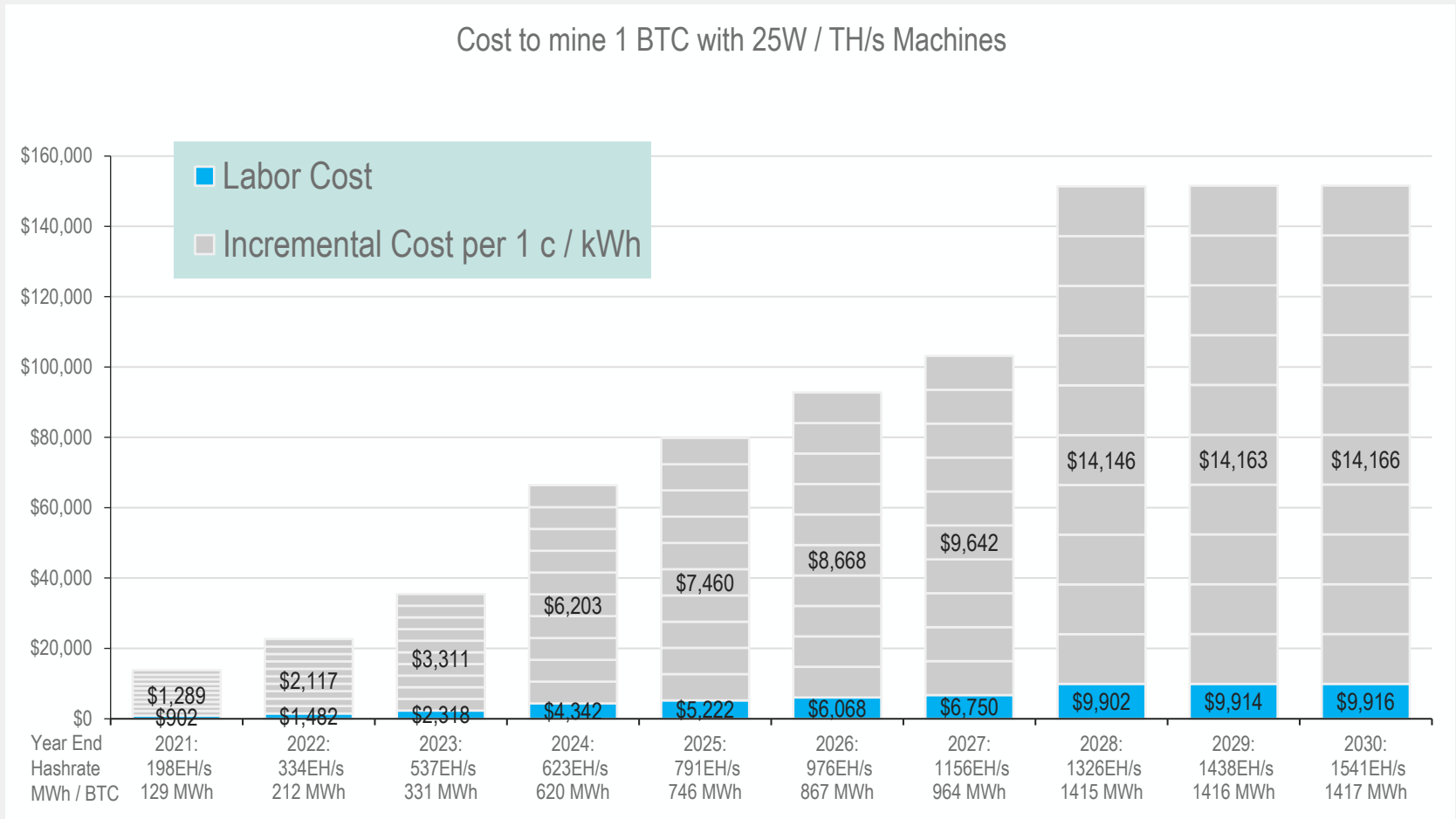


Figure: Cost to mine 1 Bitcoin using a 25 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg



Cost to Mine 1 BTC Using 20W / TH/s Rigs

- By YE 2021, it should take \$722 in labor and \$1,031 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 20W machines would be $\$722 + 1,031 \times 2 = \$2,784$
- By YE 2024, the same miner would spend \$13,400 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$13,400)

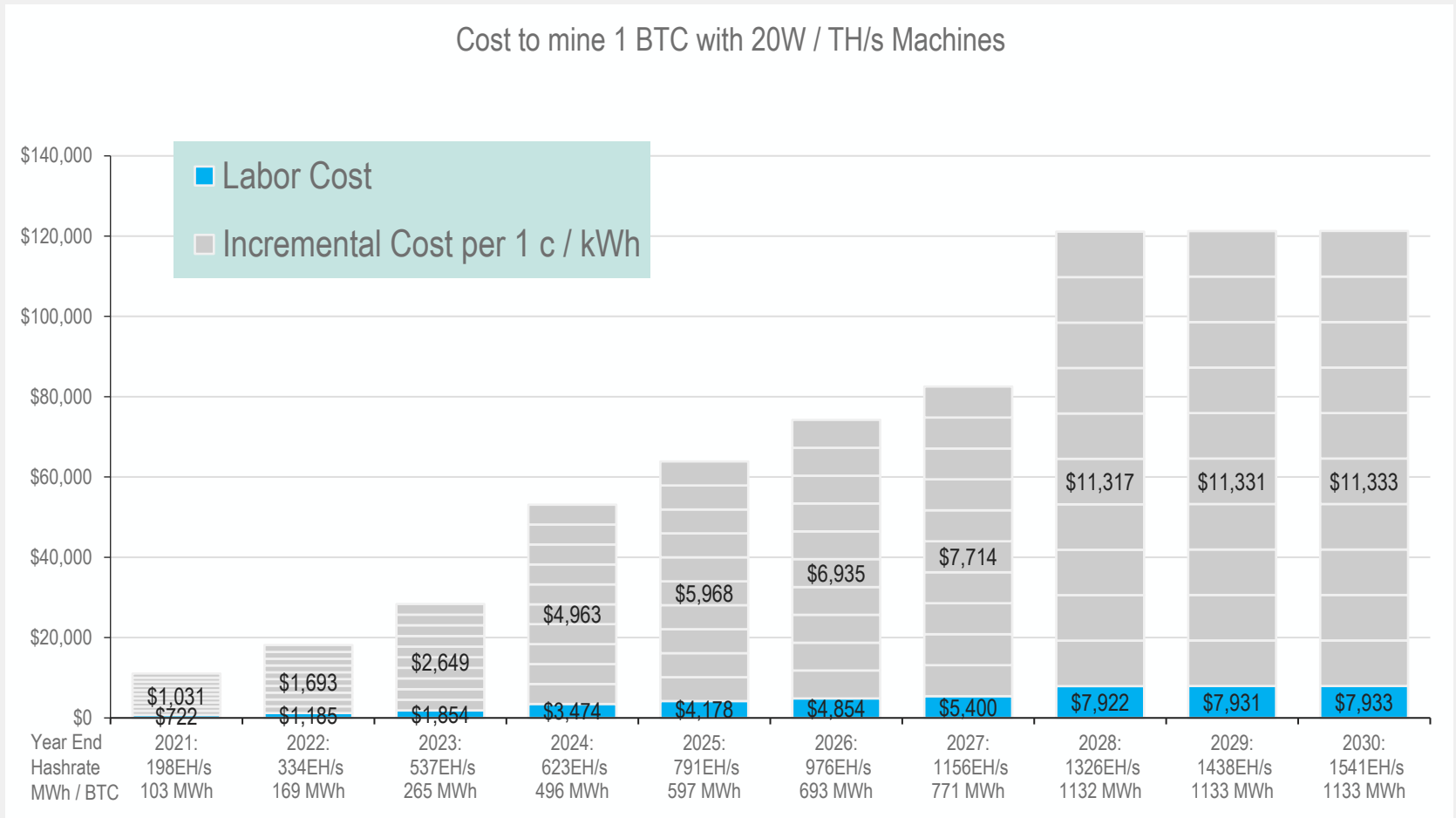


Figure: Cost to mine 1 Bitcoin using a 20 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg

Cost to Mine 1 BTC Using 15W / TH/s Rigs

- By YE 2021, it should take \$541 in labor and \$773 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 15W machines would be $\$541 + 773 \times 2 = \$2,087$
- By YE 2024 end, the same miner would spend \$10,049 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$10,049)

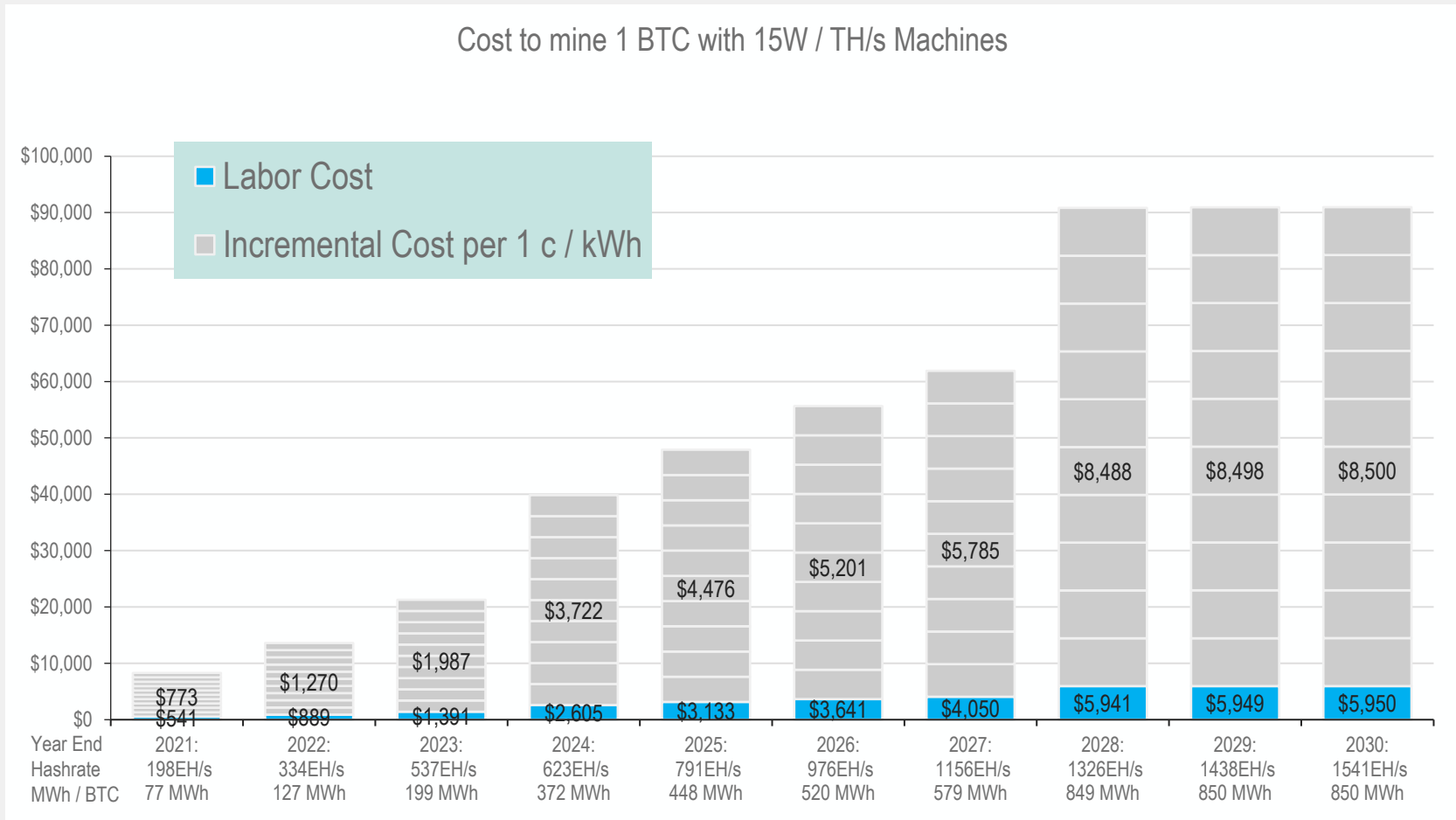


Figure: Cost to mine 1 Bitcoin using a 15 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg



Cost to Mine 1 BTC Using 10W / TH/s Rigs

- By YE 2021, it should take \$361 in labor and \$515 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 10W machines would be $\$361 + 515 \times 2 = \$1,391$
- By YE 2024, the same miner would spend \$6,699 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$6,699)

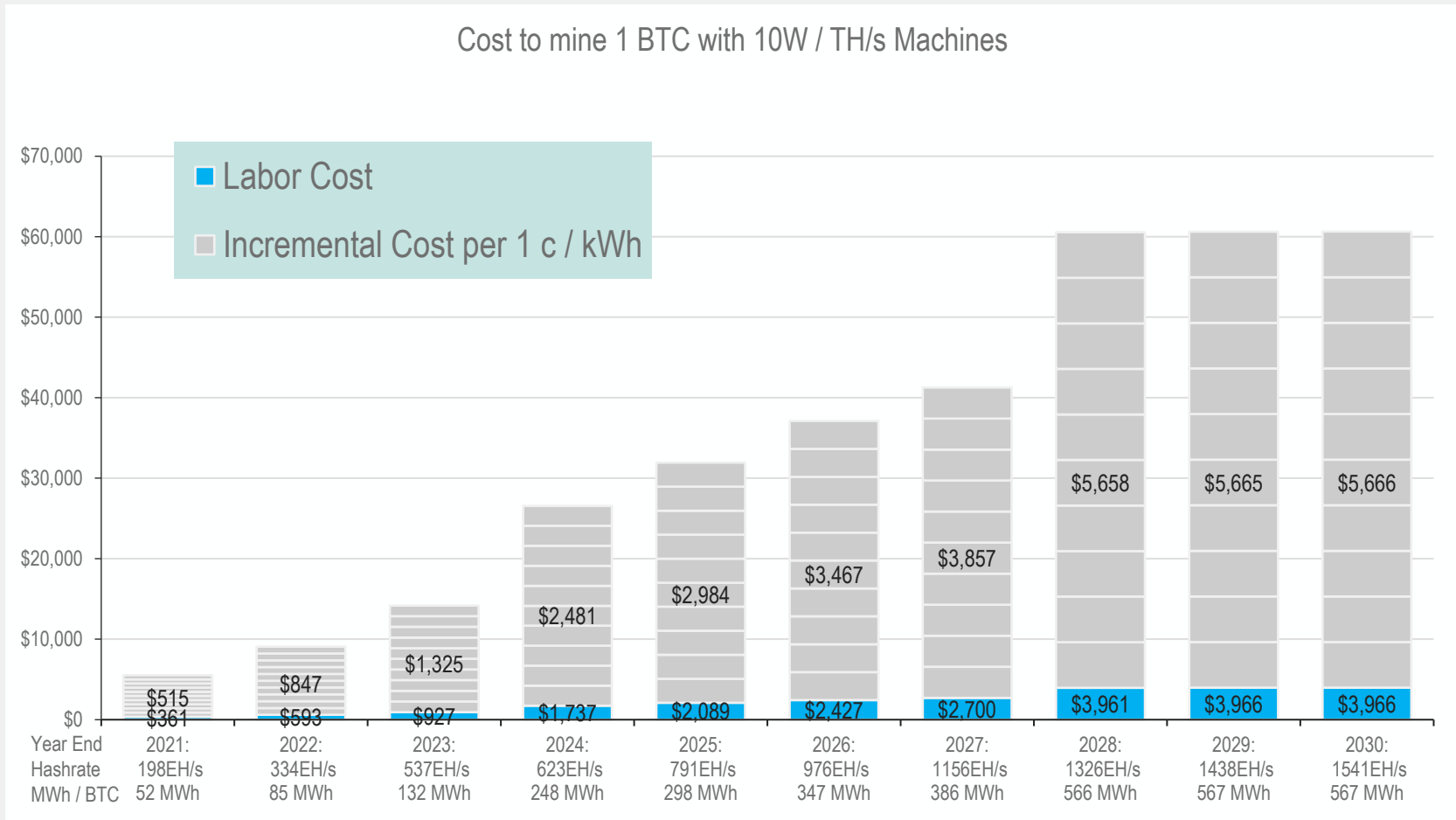


Figure: Cost to mine 1 Bitcoin using a 10 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg



Cost to Mine 1 BTC Using 5W / TH/s Rigs

- By YE 2021, it should take \$180 in labor and \$258 in power cost per 1c/kWh price to produce 1 BTC
- Thus, if a miner's power cost was 2 c/kWh, the cost to produce 1 BTC on 5W machines would be $\$180 + 258 \times 2 = \696
- By YE 2024, the same miner would spend \$3,350 on this older equipment, assuming Bitcoin price is higher than that (i.e., \$3,350)

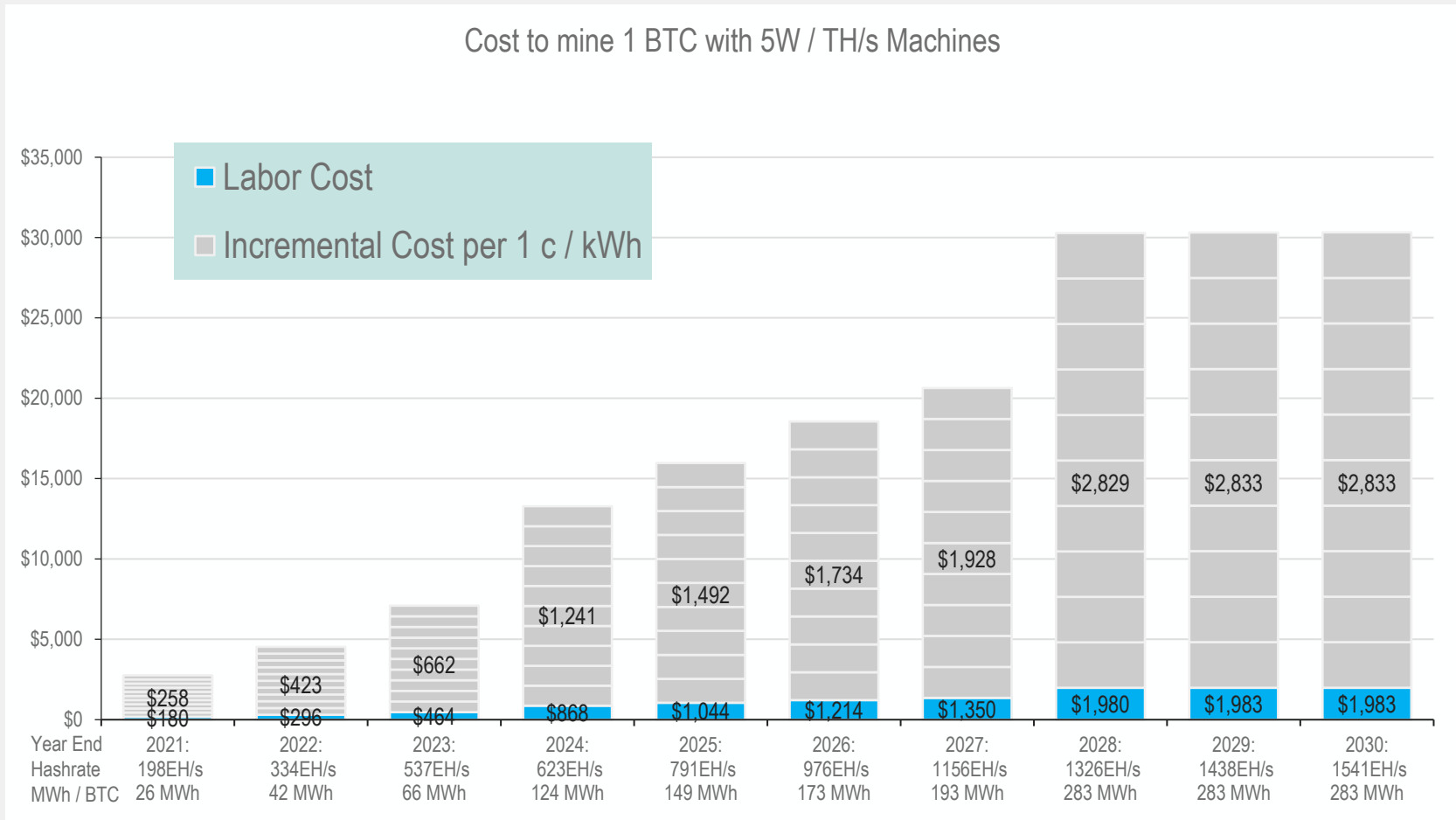


Figure: Cost to mine 1 Bitcoin using a 5 W/TH/s rig, where each grey segment represents 1 c / kWh; for example, the top of the stack shows labor cost plus 10 x cost per 1 c / kWh

Source: BitOoda, CoinMetrics, Bloomberg

Reserve of ~5 BTC / PH through 2030

Front End Loaded

- A PH/s of capacity running continuously will earn 5.013 BTC by the end of 2030
- 12% of that “mining reserve,” as we call it, will be mined in the remainder of 2021 and another 30% in 2022
- This underscores our thesis that time to market is a key factor for any project

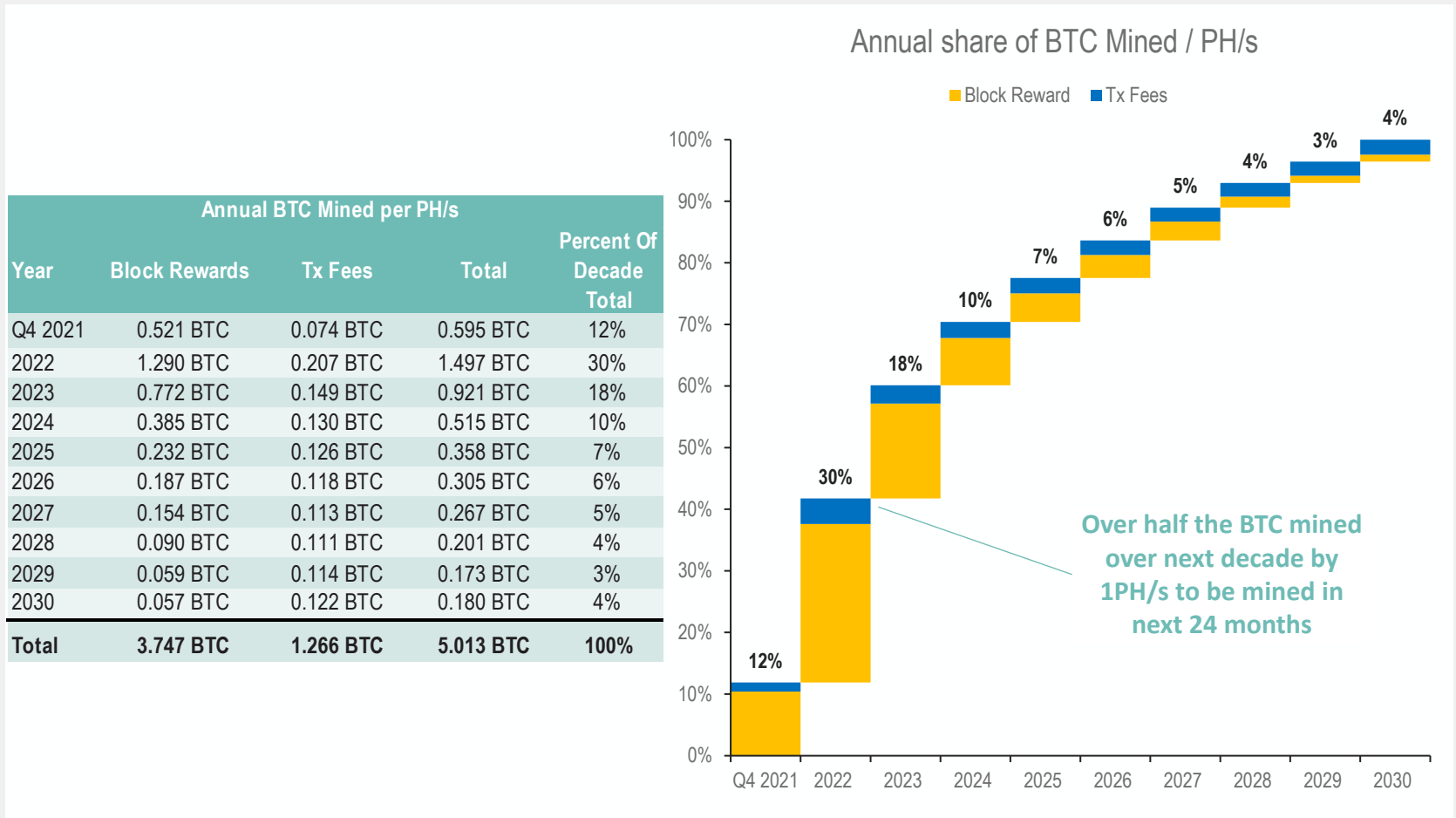


Figure: Projected BTC earned per PH/s annually through 2030

Source: BitOoda estimates, CoinMetrics





~171 BTC / MW Reserve Through 2030

- Our equipment upgrade estimates suggest we could ultimately get 51 PH/s per MW of capacity, compared with 26 PH/s with current S19-class rigs, including a 12% PUE
- This leads us to a ~171 BTC “mining reserve” per MW capacity through 2030
- Two key assumptions that may not hold true, though, are continuous operation and immediate upgrades to the latest technology
- **As a practical matter, the BTC reserve could be meaningfully lower if we skipped a generation while upgrading, and/or if there is intermittency of power supply**

Annual BTC Mined per MW				Percent Of Decade Total
Year	Block Rewards	Tx Fees	Total	
Q4 2021	13.502 BTC	1.929 BTC	15.431 BTC	9%
2022	33.442 BTC	5.371 BTC	38.813 BTC	23%
2023	26.750 BTC	5.171 BTC	31.921 BTC	19%
2024	15.209 BTC	5.151 BTC	20.360 BTC	12%
2025	9.187 BTC	4.966 BTC	14.153 BTC	8%
2026	7.377 BTC	4.661 BTC	12.038 BTC	7%
2027	6.920 BTC	5.103 BTC	12.023 BTC	7%
2028	4.045 BTC	5.019 BTC	9.065 BTC	5%
2029	2.668 BTC	5.128 BTC	7.797 BTC	5%
2030	2.933 BTC	6.296 BTC	9.229 BTC	5%
Total	122.034 BTC	48.795 BTC	170.829 BTC	100%

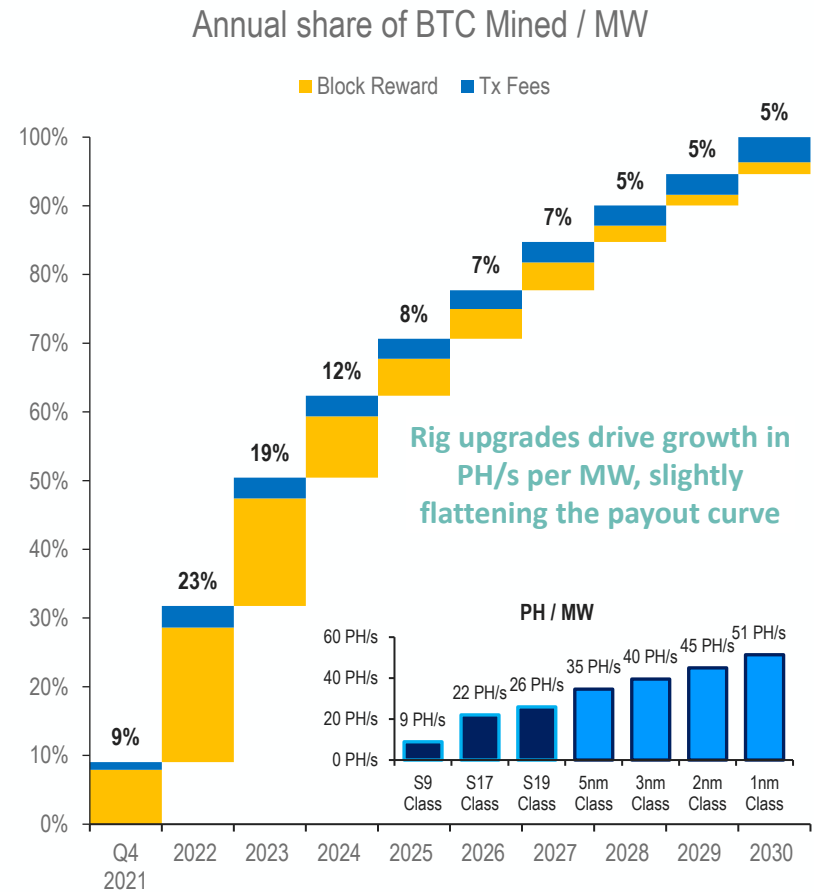


Figure: Projected BTC earned per MW annually through 2030

Source: BitOoda estimates, CoinMetrics



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