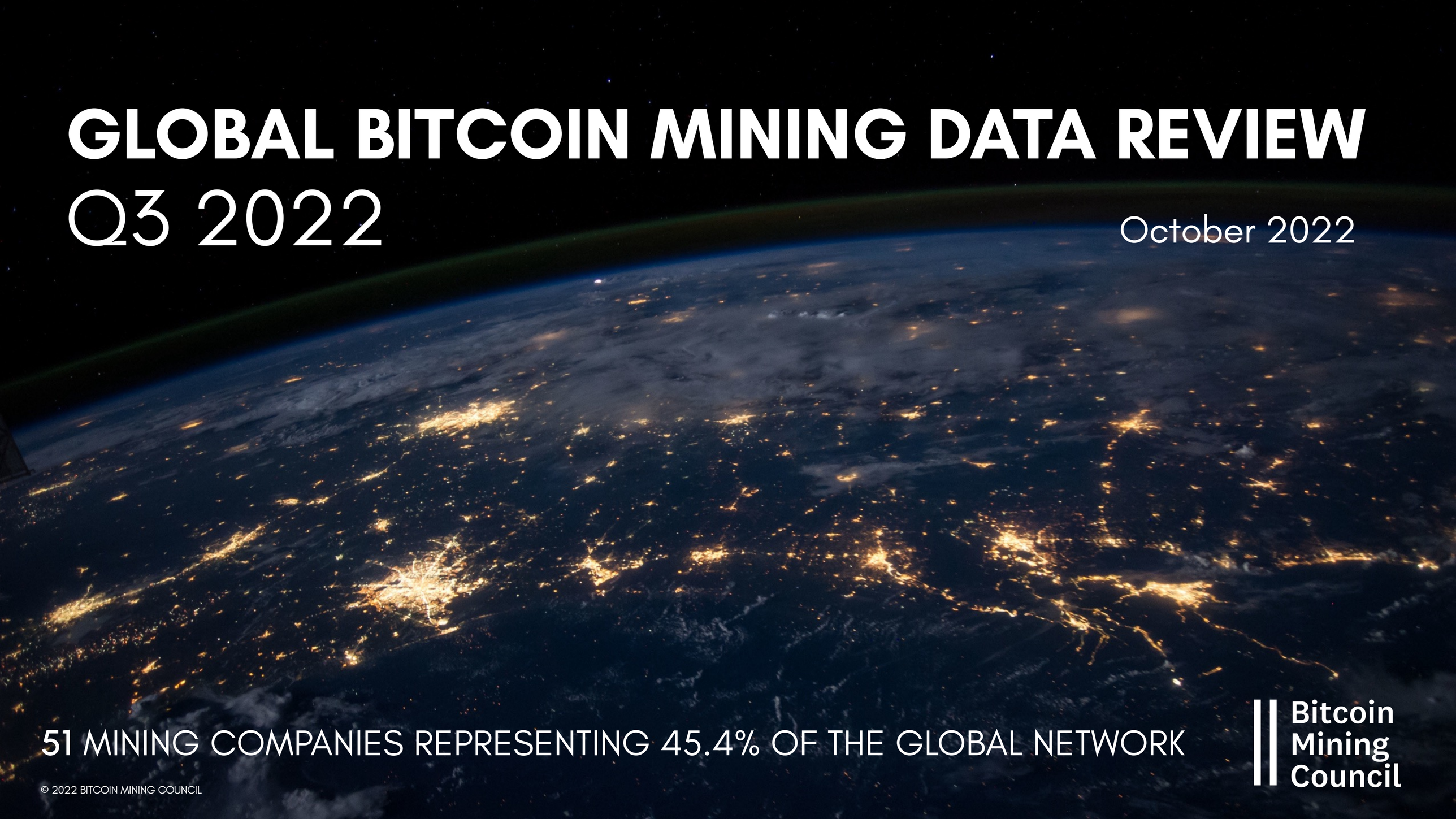
GLOBAL BITCOIN MINING DATA REVIEW

Q3 2022

October 2022



51 MINING COMPANIES REPRESENTING 45.4% OF THE GLOBAL NETWORK

Bitcoin Mining Council

AGENDA

1. Introduction: Michael Saylor
2. Full BMC Q3 2022 Update: Ben Gagnon
3. Impact of Ethereum Merge: Will Foxley
4. Grid Stabilization Initiatives: Romain Nouzareth
5. Q & A

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BITCOIN MINING COUNCIL

51 MINING COMPANIES FROM **5** CONTINENTS REPRESENTING **45.4%** OF THE GLOBAL NETWORK

argo
ARKON ENERGY
ATLAS MINING
atnorth
BIT5IVE
BITDEER
BIT DIGITAL
Bitfarms
BITFURY
BITQUEST
BITRIVER
BlockFi
BLOCKFUSION
BLOCKWARE MINING
BLOCKWARE SOLUTIONS
BTCM
celsius network
CORE SCIENTIFIC
COMPASS MINING
COMPUTENORTH
Cowa
cormint
DELTA MINING
DMG BLOCKCHAIN SOLUTIONS
FRONTIER MINING
galaxy
GEM MINING
GMR
GMT
HIVE
HORIZON KINETICS
HUT 8
HM Tech LLC
HASH WITH THE MASTER
Iris Energy
JKL MINING
MARATHON DIGITAL HOLDINGS
Mawson Infrastructure Group Inc.
MicroStrategy
MININGSTORE
MONBANC
Managed Crypto Mining
NFN8GROUP INC
Leveraging the Evolution of Money
Poolin
PrimeBlock
RIOT
SATO
SBI Crypto
STRONGHOLD DIGITAL MINING
SOLOMON DATA SYSTEMS
SOLUNA
TERAWULF
TRUE NORTH DATA SOLUTIONS LTD
US BITCOIN CORP

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EXECUTIVE SUMMARY

Bitcoin mining, in Q3 2022:

1. Uses an inconsequential amount of global energy (**16bps**) and generates negligible carbon emissions (**10bps**)
2. Bitcoin mining hashrate is up **73%** YoY while energy usage is up **41%** YoY, due to an increase in efficiency of **23%**
3. Bitcoin is the industry leader in sustainability with a **59.4%** sustainable energy mix
4. Bitcoin is the most secure crypto network, 100x more powerful than all competing networks combined.

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PRESENTATION OVERVIEW

1. Bitcoin Mining Energy Use Vs Global Energy Use
2. Bitcoin Mining Carbon Generation Vs Global Carbon Generation
3. Global Bitcoin Mining Energy Use Is Negligible
4. Global Bitcoin Mining Has The Highest Sustainable Energy Mix
5. Global Bitcoin Mining Vs Other Industries
6. Q3-22, Mining Efficiency Increased 3% & Sustainable Electricity Remained Equal
7. YoY, Mining Efficiency Increased 23% and Sustainable Electricity Mix Increased 3%
8. Bitcoin Mining Is Technology Intensive, 58x+ In Efficiency In 8 Years
9. Conclusion: Bitcoin Mining Energy Efficiency Is Improving, Rapidly
10. Sources And Methodology

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BITCOIN MINING ENERGY USE VS TOTAL GLOBAL ENERGY USE

165,317 TWh[i]

TOTAL ENERGY UTILIZED WORLDWIDE

266 TWh[ii]

ENERGY CONSUMED BY BITCOIN MINING ON THE WORLD'S ELECTRIC GRID

GLOBAL BITCOIN MINING CONSUMES 0.16%

OF THE WORLD'S ENERGY PRODUCTION

SOURCES: [i] BP STATISTICAL REVIEW OF WORLD ENERGY (2021), HTTPS://WWW.BP.COM/EN/GLOBAL/CORPORATE/ENERGY-ECONOMICS/STATISTICAL-REVIEW-OF-WORLD-ENERGY/PRIMARY-ENERGY. [ii] BMC ESTIMATED BITCOIN MINING ENERGY USE (September 30, 2022).

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BITCOIN MINING CARBON EMISSIONS VS TOTAL GLOBAL CARBON EMISSIONS

34.8 BMt[i]

TOTAL ESTIMATED CO^2 GENERATED GLOBALLY

0.04 BMt[ii]

ESTIMATED CO^2 GENERATED BY BITCOIN MINING ON THE WORLD'S ELECTRIC GRID

GLOBAL BITCOIN MINING IS 0.10%

OF THE WORLD'S CO^2 PRODUCTION

SOURCES: [i] CO^2 EMISSIONS ARE ESTIMATED BY EXTRAPOLATING U.S. CARBON EMISSIONS GENERATED BY ELECTRICAL GENERATION. HTTPS://WWW.EIA.GOV/TOOLS/FAQS/FAQ.PHP?ID=74&T=11
[ii] BITCOIN MINING ESTIMATE IS DERIVED FROM THE Q3 2022 BMC ESTIMATED TWH ELECTRICITY CONSUMED GLOBALLY.

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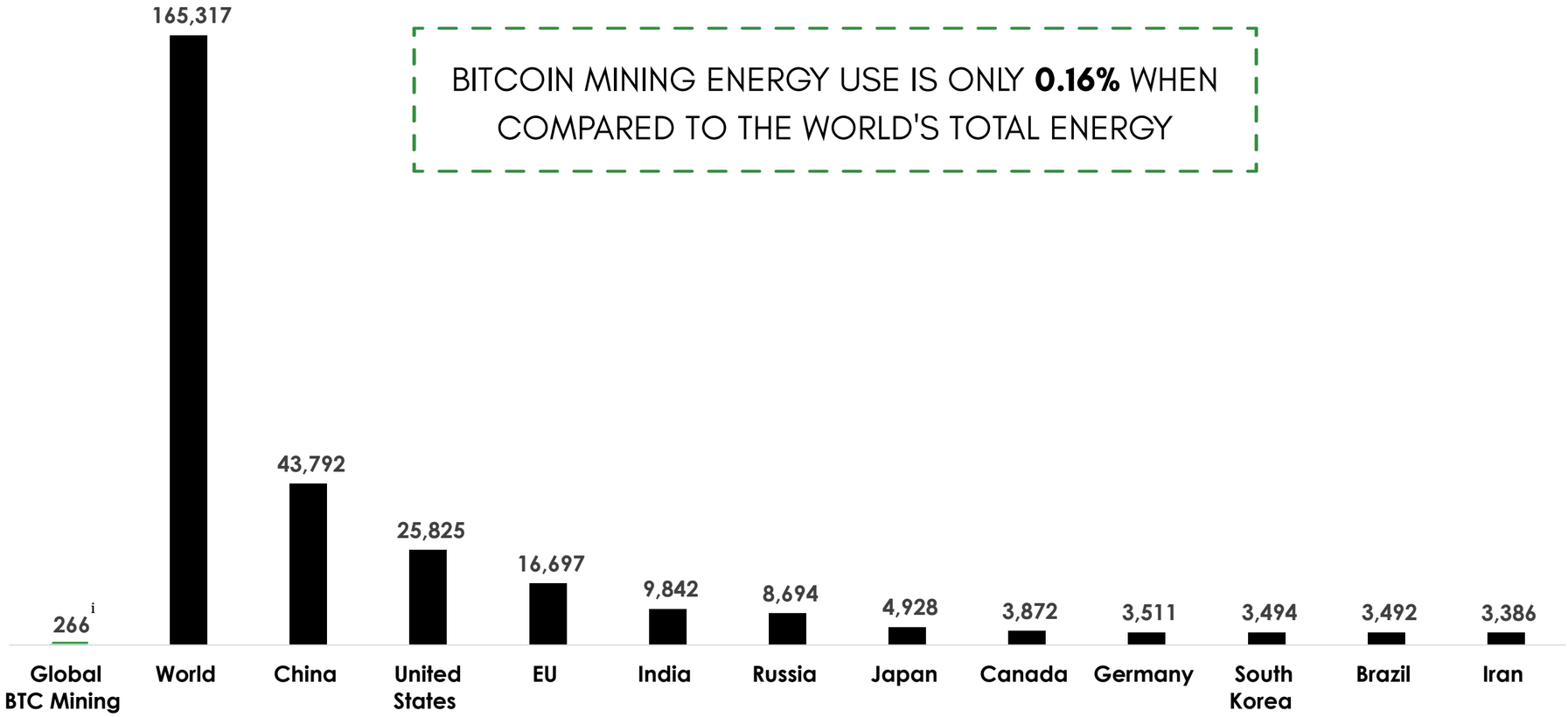
GLOBAL BITCOIN MINING ENERGY USE IS NEGLIGIBLE

BITCOIN MINING VS COUNTRIES (TWh)[ii]



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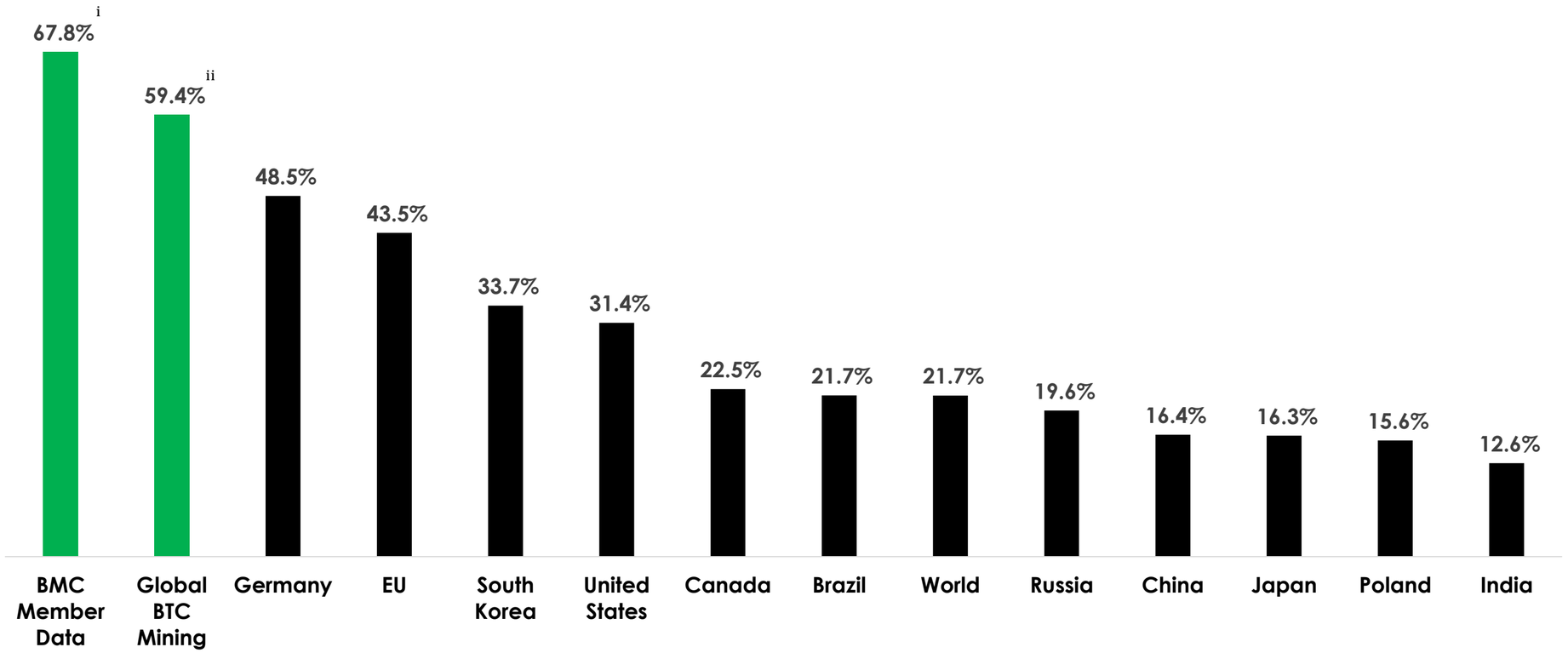
GLOBAL BITCOIN MINING HAS THE HIGHEST SUSTAINABLE ENERGY MIX

SUSTAINABLE POWER MIX: BITCOIN MINING VS COUNTRIES (% OF TWh) [iii]



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[iii] COUNTRY DATA COMPILED FROM BP'S STATISTICAL REVIEW OF WORLD ENERGY (2022). HTTPS://WWW.BP.COM/EN/GLOBAL/CORPORATE/ENERGY-ECONOMICS/STATISTICAL-REVIEW-OF-WORLD-ENERGY/PRIMARY-ENERGY.

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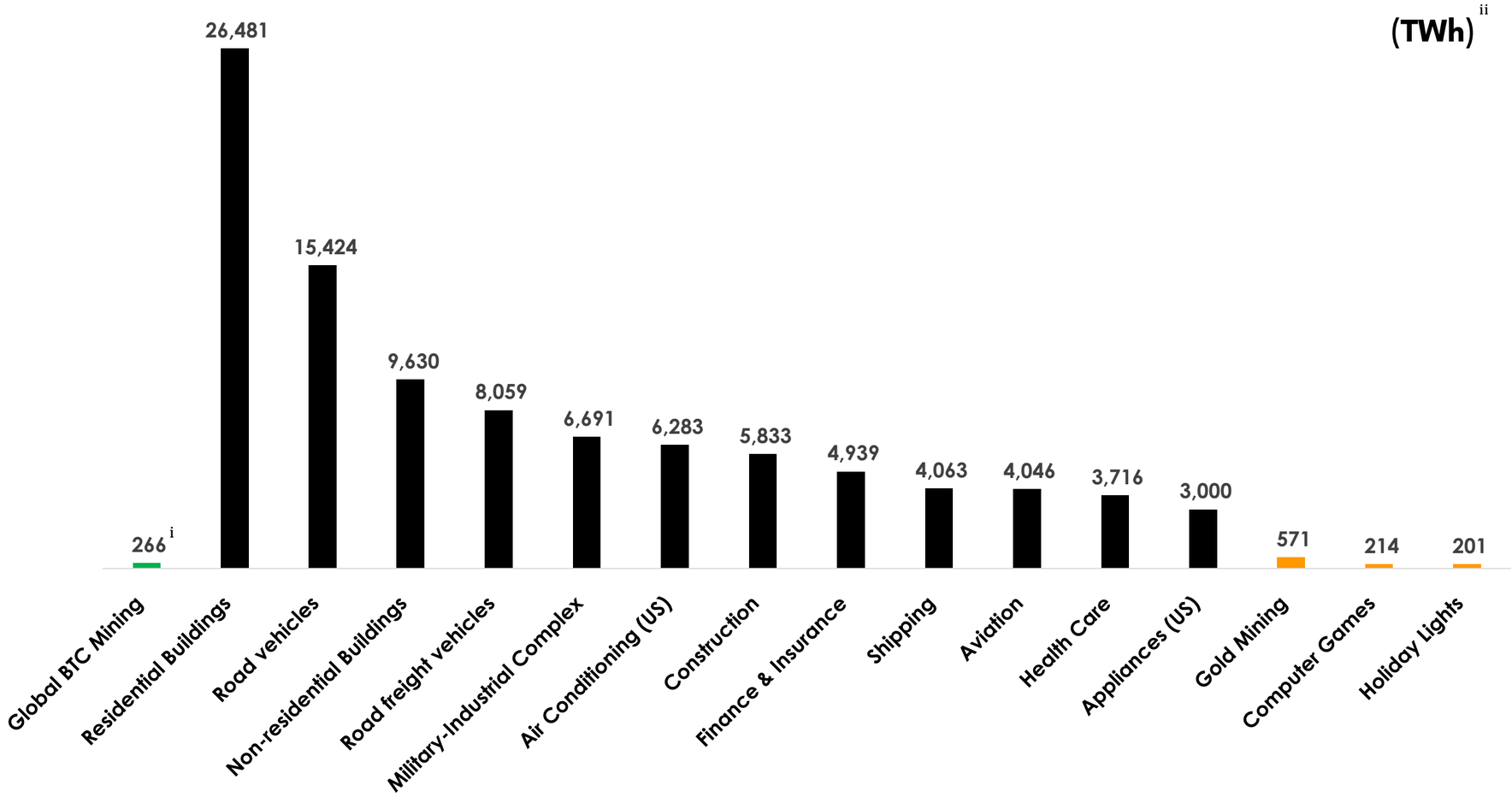
GLOBAL BITCOIN MINING VS OTHER INDUSTRIES



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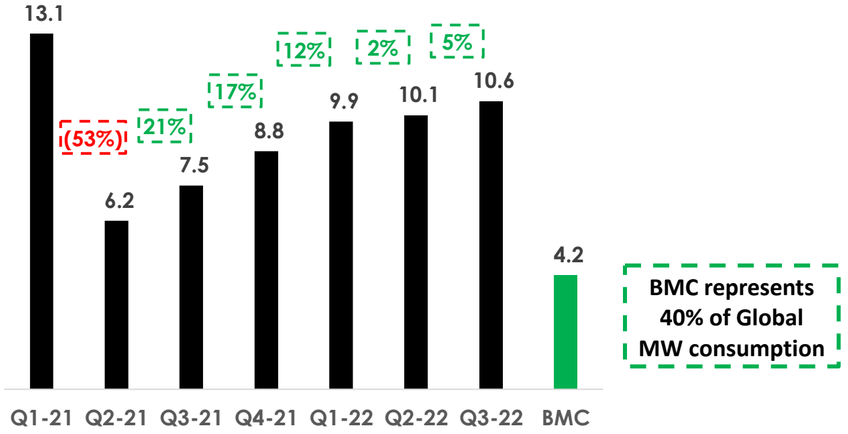
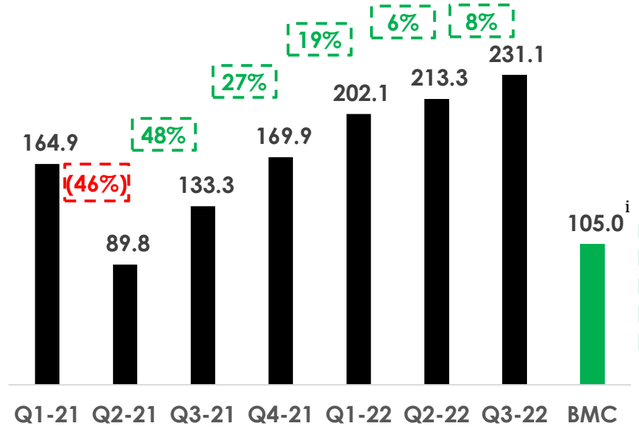
DURING Q3-22, MINING EFFICIENCY INCREASED 3% AND NETWORK SECURITY INCREASED 8%

FLEET ELECTRICITY CONSUMPTION (GW) [ii]



BMC represents 40% of Global MW consumption

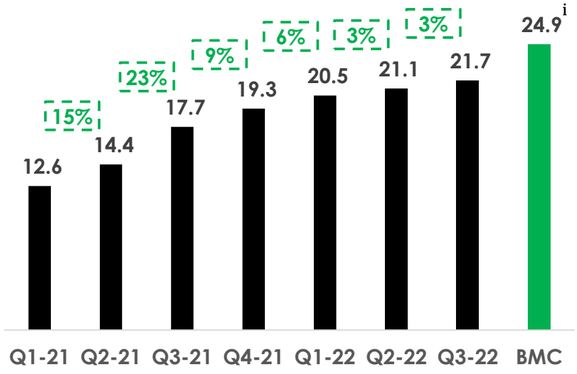
HASHRATE (EH) [ii]



[i]

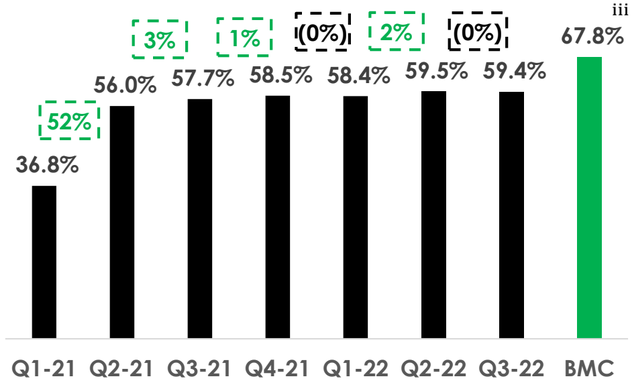
BMC represents 45.4% of Global Hashrate, an increase from 35EH from the first BMC survey

MINING EFFICIENCY (EH/GW) [ii]



[i]

SUSTAINABLE ELECTRICITY (%) [ii]



[iii]

SOURCES: [i] DATA COMPILED FROM BMC ADVISORY COUNCIL MEMBERS. ANNUALIZED VALUES ARE USED FOR BITCOIN MINING ENERGY AND ELECTRICITY USE.
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[iii] As of Q4-21, BMC SUSTAINABILITY ELECTRICITY VALUE NO LONGER TAKES INTO ACCOUNT RENEWABLE ENERGY CREDITS (REC).

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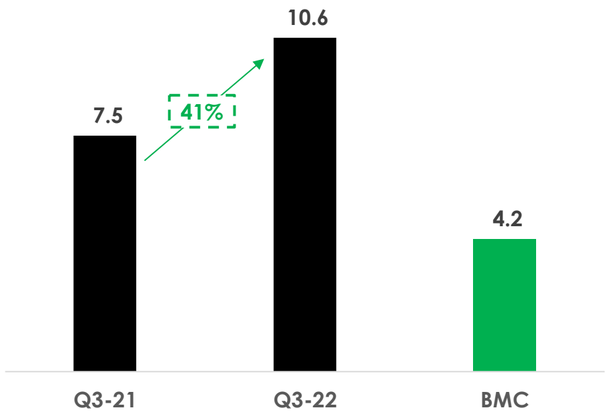
YoY, MINING EFFICIENCY INCREASED 23% AND SECURITY INCREASED 73%

FLEET ELECTRICITY CONSUMPTION (GW) [ii]



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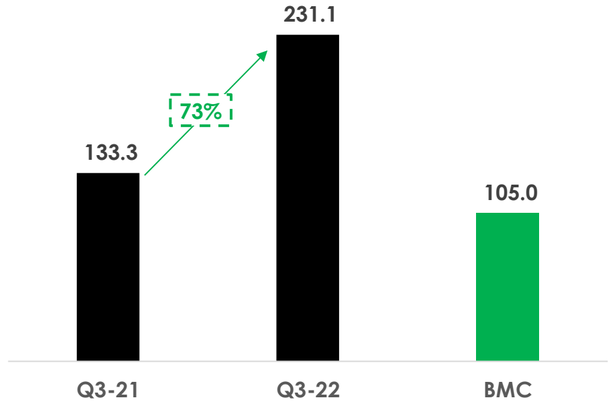

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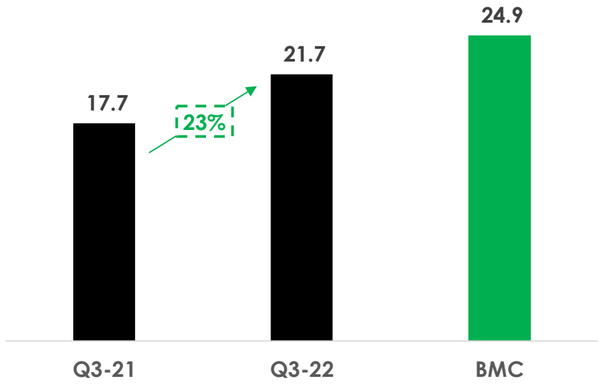

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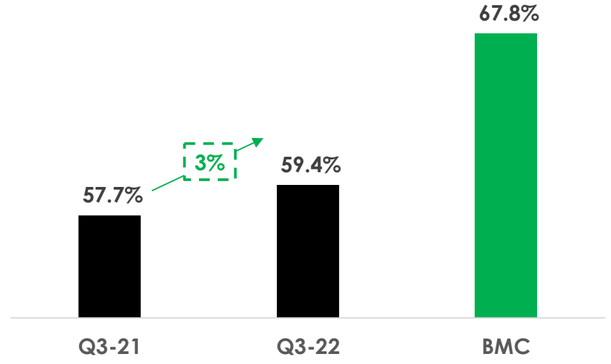

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BITCOIN MINING IS TECHNOLOGY INTENSIVE, INCREASING 58X IN EFFICIENCY OVER 8 YEARS

Combined	Hardware name	Date	J/Th
CPU	ARM Cortex A9	3-Jan-09	877,193
GPU	ATI 5870M	23-Sep-09	264,550
FPGA	X6500 FPGA Miner	29-Aug-11	43,000
ASIC - Avalon B1	Canaan AvalonMiner Batch 1	1-Jan-13	9,351
ASIC - Jupiter	KnCMiner Jupiter	5-Oct-13	1,484
ASIC - U1	Antminer U1	1-Dec-13	1,250
ASIC - BF864C55	Bitfury BF864C55	3-Mar-14	500
ASIC - RockerBox	RockerBox	22-Jul-14	316
ASIC - BE3000	ASICMiner BE300	16-Sep-14	187
ASIC - BM13850	BM1385	19-Aug-15	181
ASIC - PickAxe0	PickAxe	23-Sep-15	140
ASIC - S9	Antminer S9 - 11.5TH	1-Jun-16	98
ASIC - R4	Antminer R4	1-Feb-17	97
ASIC - Ebit 10	Ebang Ebit 10	15-Feb-18	92
ASIC - S15	Antminer S15	9-Apr-18	59
ASIC - S17	Antminer S17	9-Apr-19	39.5
ASIC - S19	Antminer S19 Pro	23-Mar-20	29.5
ASIC - S19 XP	Antminer S19 Pro	12-Nov-21	21.5

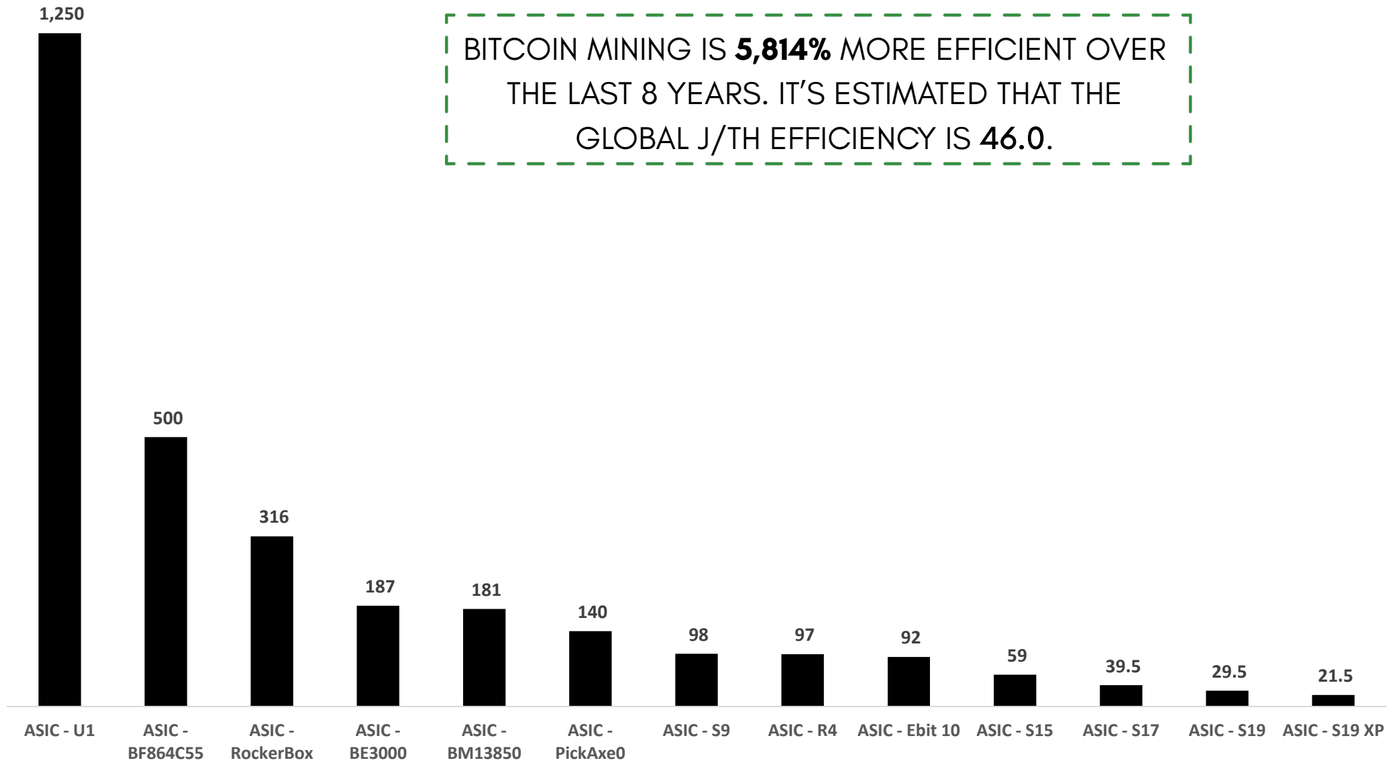
~700x

~13x

5x

J/TH - EFFICIENCY OVER TIME [i]

BITCOIN MINING IS **5,814%** MORE EFFICIENT OVER THE LAST 8 YEARS. IT'S ESTIMATED THAT THE GLOBAL J/TH EFFICIENCY IS **46.0**.



SOURCES: [i] HARDWARE DATA COMPILED FROM RESPECTIVE HARDWARE MANUFACTURER WEBSITES.
OLDER GENERATION MODEL EFFICIENCY DATA FROM "THE COST OF BITCOIN MINING HAS NEVER REALLY INCREASED" (2020) HTTPS://ARXIV.ORG/PDF/2004.04605.PDF.

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CONCLUSION: BITCOIN MINING ENERGY EFFICIENCY IS IMPROVING, RAPIDLY

The Bitcoin Mining Council is estimating a 3x and 2x improvement in mining efficiency over the next four and following four years, respectively

6x

+

Satoshi's protocol reduces energy consumption incentives by 2x every 4 years, for the foreseeable future

4x

=

Bitcoin mining is guaranteed to be **dramatically more energy efficient** in the next eight years.

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BITCOIN IS 99% OF ALL CRYPTO POWER, 100 TIMES THE SECURITY OF ALL THE OTHER NETWORKS COMBINED.

Crypto	Hashrate (TH/s)	Relative to Bitcoin
Ethereum Classic	141	A grain of sand 
Dogecoin	410	A house fly 
Litecoin	467	A grain of rice 
Bitcoin	267,390,203	Mt. Fuji 

BITCOIN DOMINANCE
(99% of GLOBAL HASH)

SOURCES: [i] NETWORK HASHRATE AND POWER EFFICIENCY DATA COMPILED FROM WHATTOMINE.COM ON OCTOBER 14, 2022

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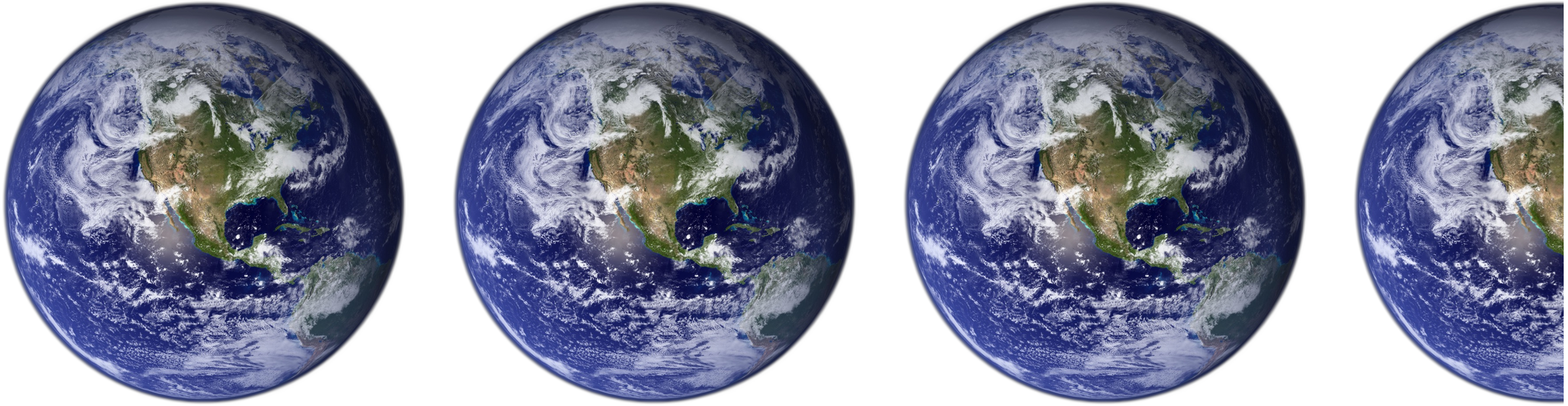
THE COMBINED POWER OF AWS, AZURE AND GOOGLE CLOUD WOULD BE LESS THAN 1% OF BITCOIN

It would take approximately 66 TW to attack the Bitcoin network using standard cloud computing hardware. The equivalent of 3.5x what the entire Earth is currently producing. Bitcoin is currently using 0.16%, making Bitcoin 2,187.5x more efficient.



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[i] [i] CLOUD COMPUTER HASHRATE AND POWER EFFICIENCY DATA PULLED FOR TESLA P100 PCIE 12 GB FROM FROM ASKGEEK.IO

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SOURCES & METHODOLOGY

BMC SURVEY METHODOLOGY:

THE BMC SURVEYED BITCOIN MINERS AROUND THE WORLD ASKING THREE QUESTIONS;
1.) HOW MUCH ELECTRICITY DOES YOUR TOTAL FLEET CONSUME TODAY?;
2.) WHAT IS THE TOTAL % OF SUSTAINABLE ELECTRICITY* WITHIN YOUR FLEET'S POWER GENERATION MIX TODAY?;
3.) WHAT IS THE TOTAL AGGREGATE HASHRATE OF YOUR FLEET TODAY?

** THE ANNOTATED TERM "SUSTAINABLE ELECTRICITY" WAS DEFINED AS ELECTRICITY GENERATED BY: HYDRO, WIND, SOLAR, NUCLEAR, GEOTHERMAL.*
THE Q3 2022 BMC SUSTAINABILITY ELECTRICITY VALUE NO LONGER TAKES INTO ACCOUNT RENEWABLE ENERGY CREDITS (REC).

SOURCES:

1 [i] BP STATISTICAL REVIEW OF WORLD ENERGY (2021), HTTPS://WWW.BP.COM/EN/GLOBAL/CORPORATE/ENERGY-ECONOMICS/STATISTICAL-REVIEW-OF-WORLD-ENERGY/PRIMARY-ENERGY.[ii] BMC ESTIMATED BITCOIN MINING ENERGY USE (September 30, 2022).

2 [i] CO2 EMISSIONS ARE ESTIMATED BY EXTRAPOLATING U.S. CARBON EMISSIONS GENERATED BY ELECTRICAL GENERATION. HTTPS://WWW.EIA.GOV/TOOLS/FAQS/FAQ.PHP?ID=74&T=11 [ii] BITCOIN MINING ESTIMATE IS DERIVED FROM THE Q3 2022 BMC ESTIMATED TWH ELECTRICITY CONSUMED GLOBALLY.

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6 & 7 [i] DATA COMPILED FROM BMC ADVISORY COUNCIL MEMBERS. ANNUALIZED VALUES ARE USED FOR BITCOIN MINING ENERGY AND ELECTRICITY USE.[ii] ESTIMATED GLOBAL BITCOIN NETWORK ANNUALIZED POWER BASED ON BMC ANALYSIS, ASSUMPTIONS AND EXTRAPOLATION.[iii] As of Q4-21, BMC SUSTAINABILITY ELECTRICITY VALUE NO LONGER TAKES INTO ACCOUNT RENEWABLE ENERGY CREDITS (REC).

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9 & 10 [i] NETWORK HASHRATE SNAPSHOT ON OCTOBER 14, 2022 COMPILED FROM HTTPS://WHATTOMINE.COM/
[i] CLOUD COMPUTE HASHRATE PERFORMANCE DATA ARE FROM HTTPS://ASKGEEK.IO/EN/GPUS/VS/AMD_RADEON-PRO-V520-VS-NVIDIA_TESLA-P100-PCIE-12-GB

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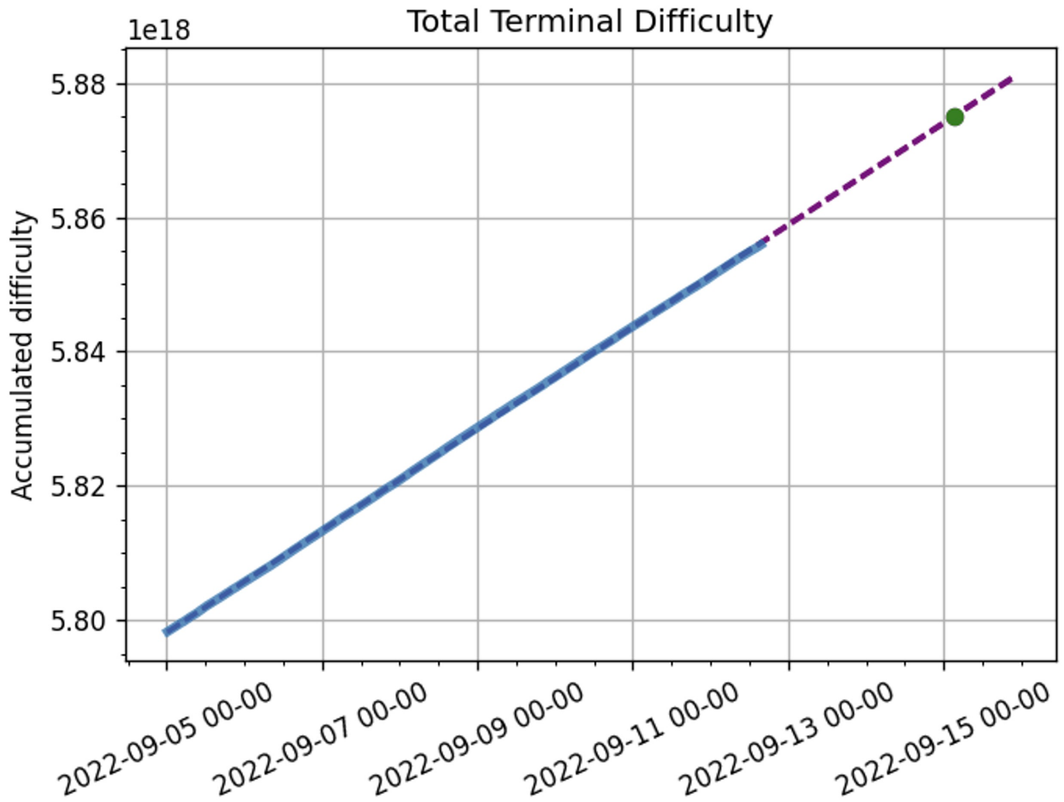
Ethereum Merge - Grafana
58750000000 TD
58749000000 TD
58748000000 TD
58747000000 TD
01:50
Current Total Difficulty
150
100
50
0
01:50
02:00
Transactions
Voluntary Exits
60
40
20
ffdcf17ac404ac4dba215b95221955a9dfddf163d0b0d, slot: 4700013
Sep 15 06:43:05.001 INFO Synced slot: 4700013, block:
empty, epoch: 146875, finalized_epoch: 146873, finalized_root: 0x9de5…49cb, exec_hash: n/a,
peers: 86, service: slot_notifier
Sep 15 06:43:05.010 INFO Ready for the merge current_difficulty: 5875000
Sep 15 06:43:13.480
state_advance
Sep 15 06:43:13.483 INFO Proof of Stake Activated slot: 4700013, service: bea
con
Sep 15 06:43:13.483 INFO Terminal POW Block Hash: 0x
55b11b918355b1ef9c5db810302ebad0bf2544255b530cdce90674d5887bb286, service: beacon
Sep 15 06:43:13.485 INFO Merge Transition Block Root
: 0x810a00400a80cdffc11ffdcf17ac404ac4dba215b95221955a9dfddf163d0b0d, service: beacon
Sep 15 06:43:13.485 INFO Merge Transition Execution
Hash: 0x56a9bb0302da44b8c0b3df540781424684c3af04d0b7a38d72842b762076a664, service: beacon
Sep 15 06:43:13.555 INFO New RPC block received hash: 0x810a…0b0d, slot: 47
00013

“The Merge”

The How and When

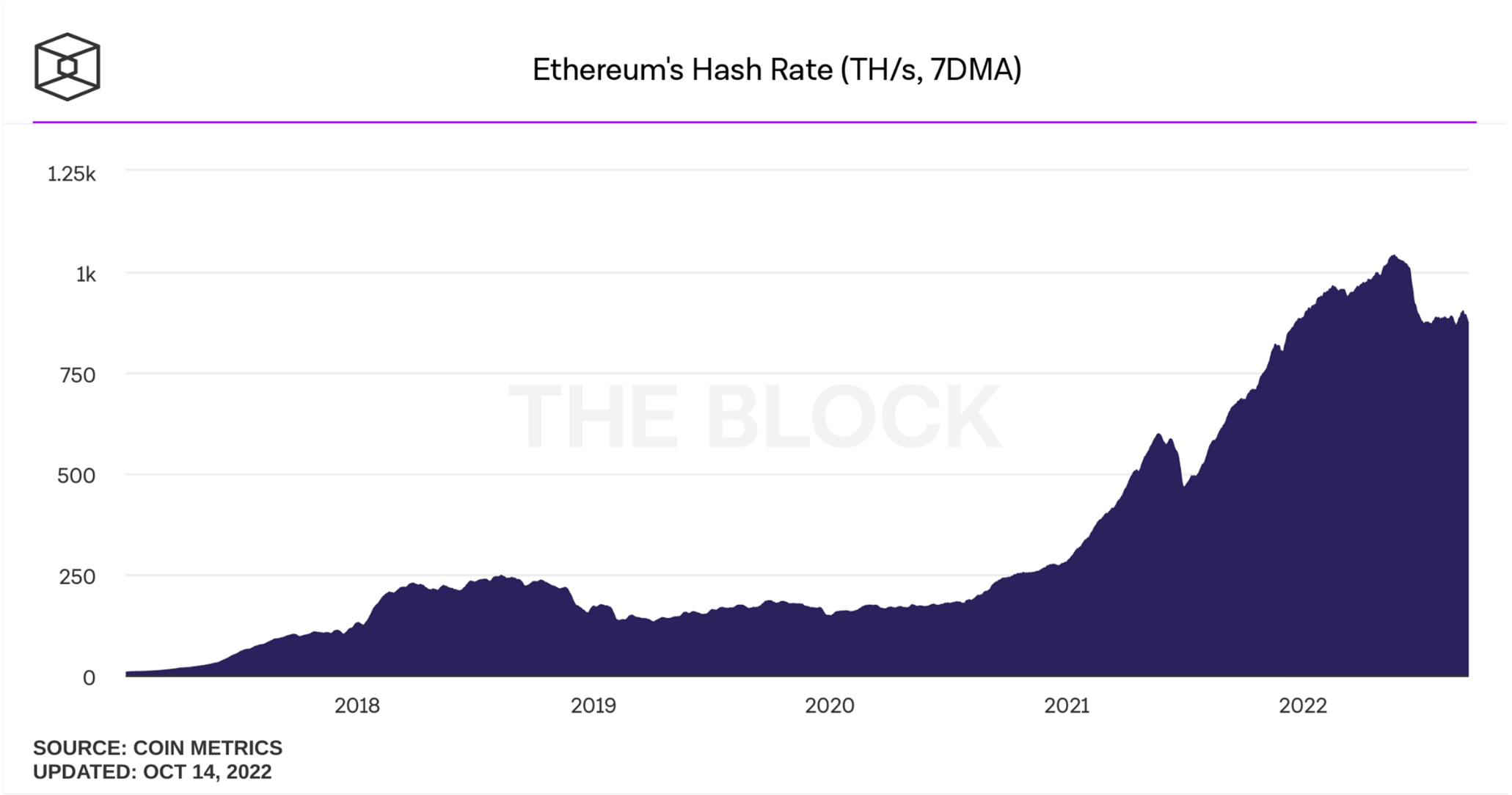
- Ethash Proof-of-Work algorithm to Gasper FFG Proof-of-Stake algorithm.
- Occurred at Total Terminal Difficulty (TTD), not block height.
- Reduce chance of miners interfering with change.



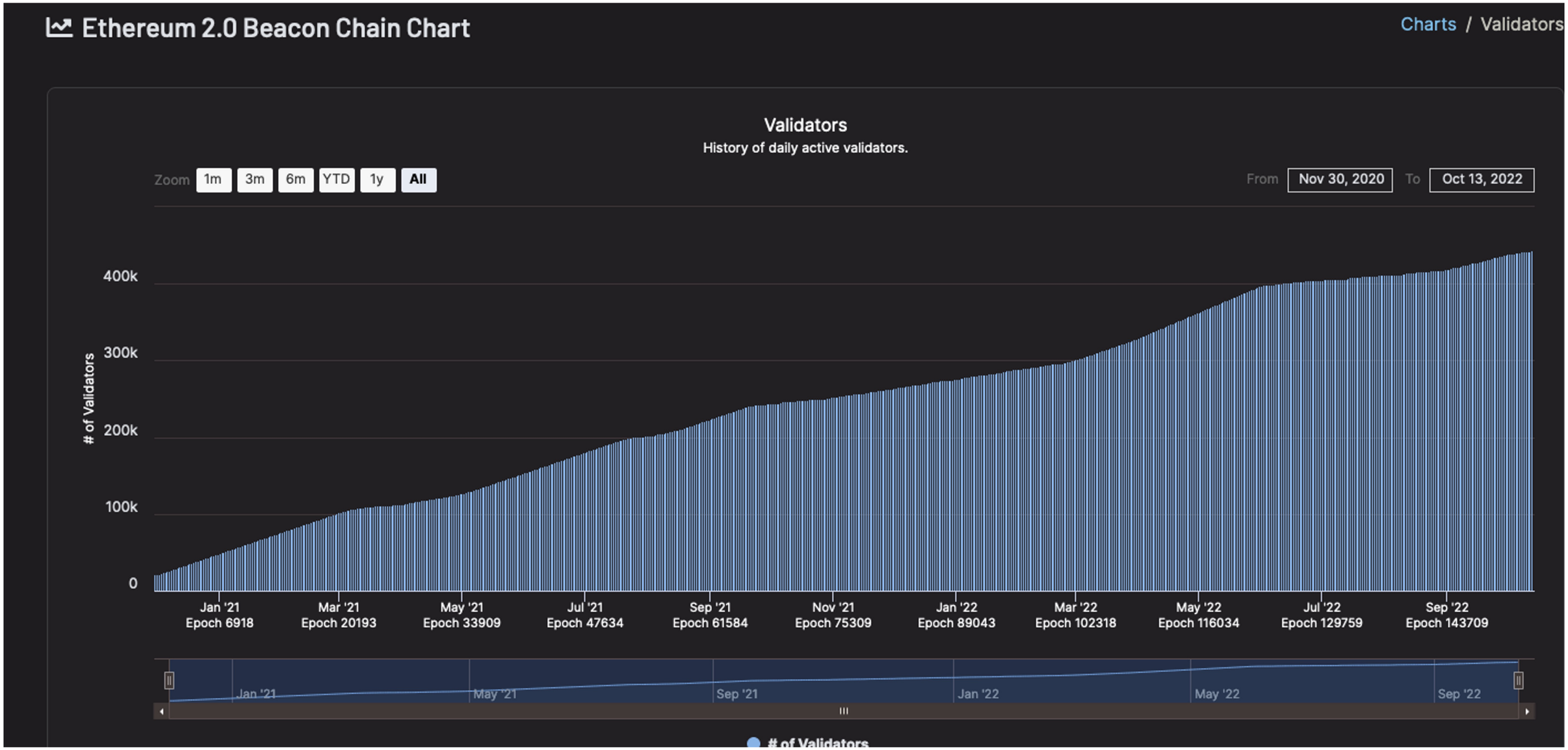
What’s Happened Since?

1. Smooth operation for the Proof-of-Stake network
2. Dubious energy claims
3. Unemployed Ethereum miners
4. Censorship concerns mounting

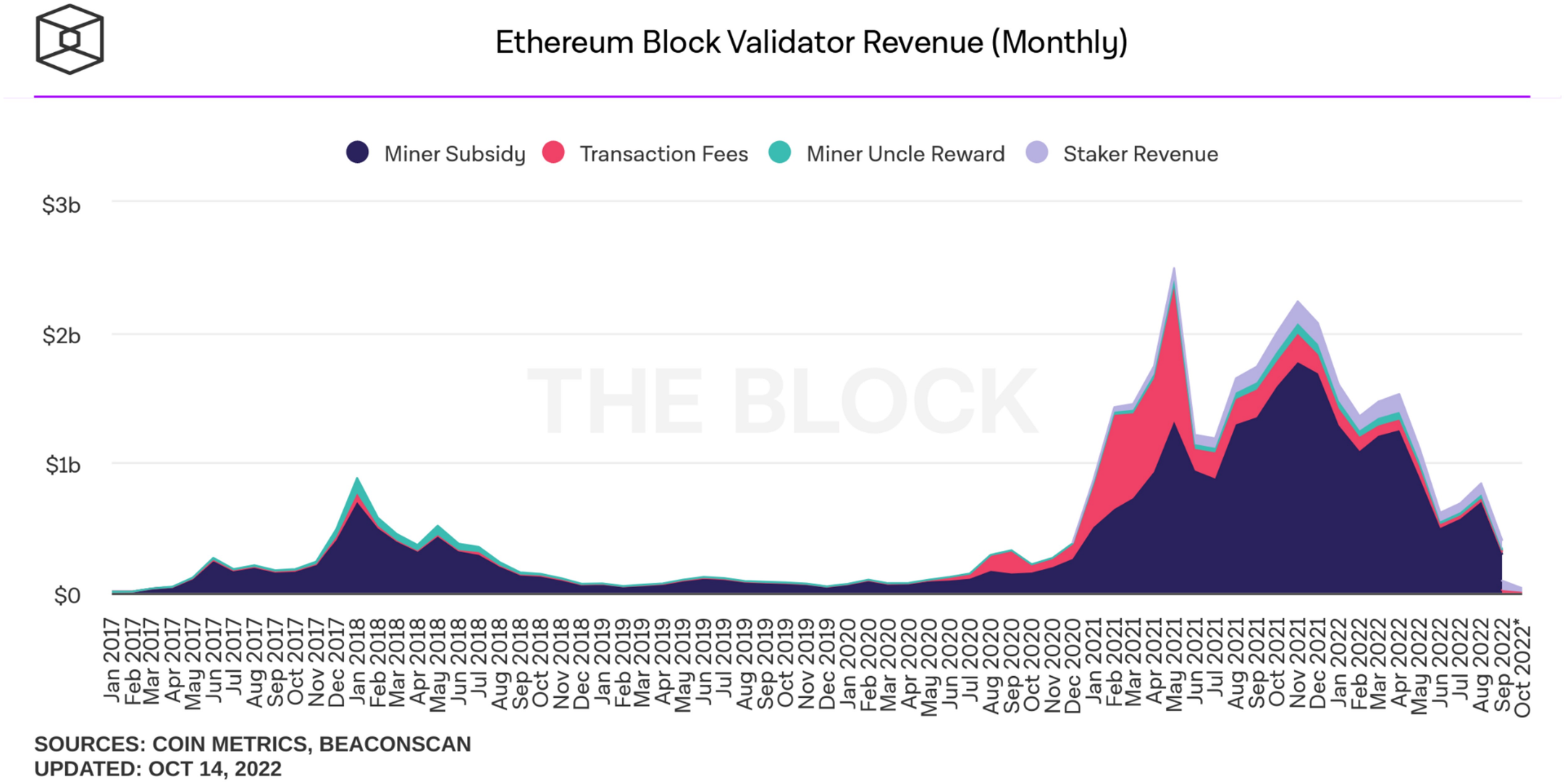
Proof-of-Stake operations



Proof-of-Stake operations



Performance Since The Merge



SOURCES: COIN METRICS, BEACONSCAN
UPDATED: OCT 14, 2022

More energy efficient?

The Merge – Implications on the Electricity Consumption and Carbon Footprint of the Ethereum Network

(Crypto Carbon Ratings Institute; commissioned by ConsenSys)

	Ethereum PoW	Ethereum PoS	Reduction factor
Electricity consumption [MWh/year]	22,900,320	2,600.86	0.99988
CO_2e emissions [t/year]	11,016,000	869.78	0.99992

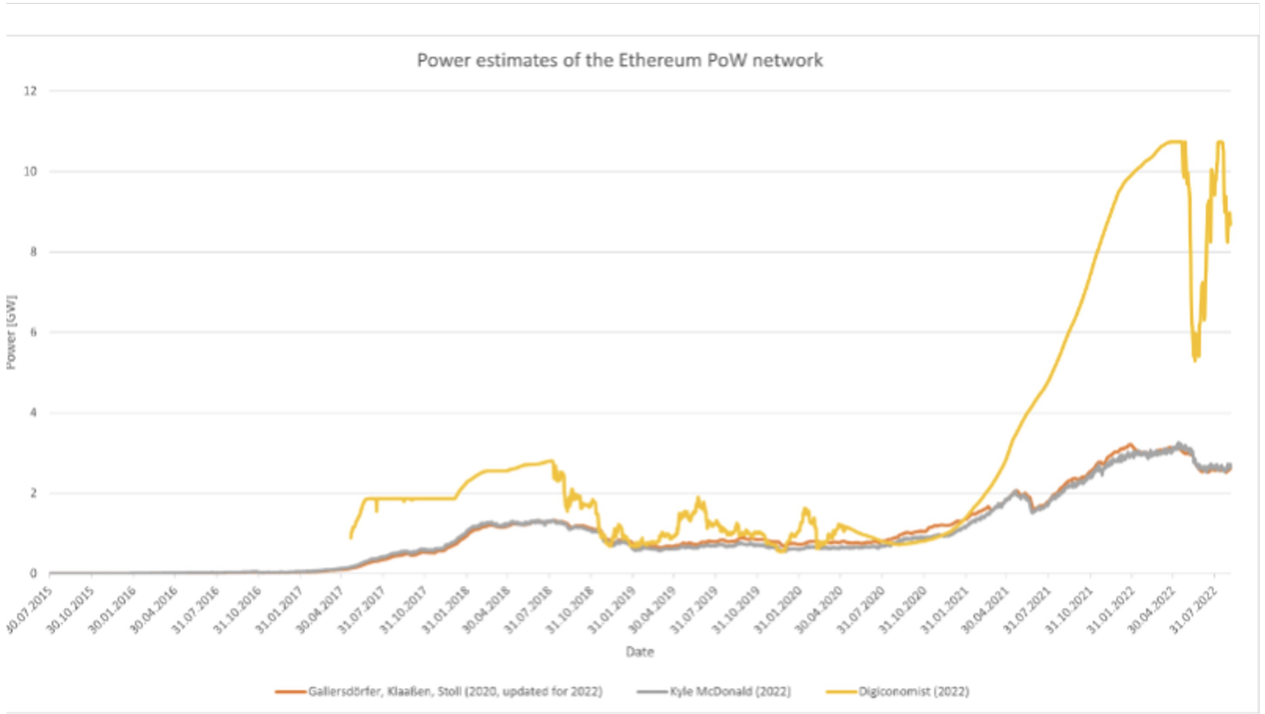


Figure 1: Estimates of power usage of the Ethereum network by Gallersdörfer et. al, Kyle McDonald and Digiconomist. Data from Digiconomist is transformed to GW to align

Unemployed Ethereum Miners

Seeking future revenue streams:

- Artificial intelligence
- Graphics rendering
- Altcoins
- Zero Knowledge Proofs

Down Only for GPU Mining Alternatives

	# ▲	Name	Price	Last 30 Days	30d %	
★	2	Ethereum ETH	$1,295.11		▼21.12%	⋮
★	23	Ethereum Classic ETC	$22.98		▼40.74%	⋮
★	211	EthereumPoW ETHW	$7.13		▼79.64%	⋮
★	235	Ergo ERG	$2.21		▼56.28%	⋮
★	460	Kaspa KAS	$0.002286		▼42.92%	⋮
★	--	Raven RAVEN	--	--	--	⋮

Biggest risk? Censorship

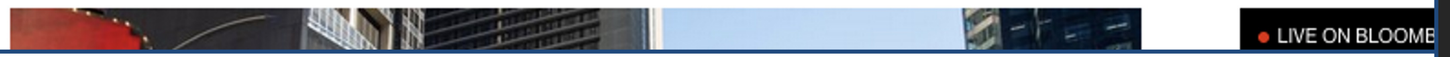
PRESS RELEASES

U.S. Treasury Sanctions Notorious Virtual Currency Mixer Tornado Cash

Industries | **Technology** | Politics | Wealth | Pursuits | Opinion | Businessweek | Equality | Green | City

Coinbase Is Helping Sue The US Treasury Over Tornado Cash Sanctions

- Coinbase will pay legal costs for six people challenging OFAC
- The complaint argues that Treasury overstepped its authority

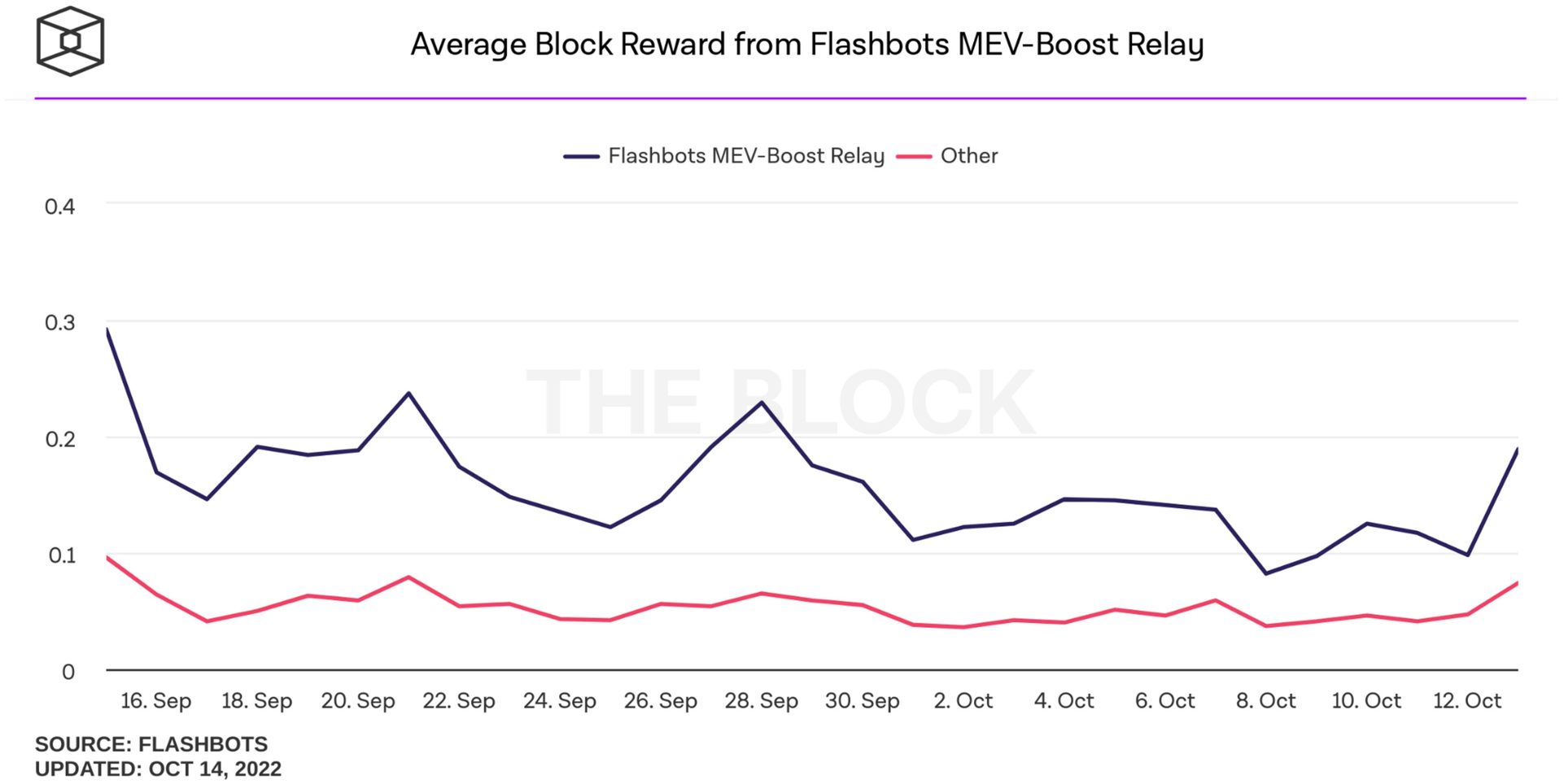


Opinion

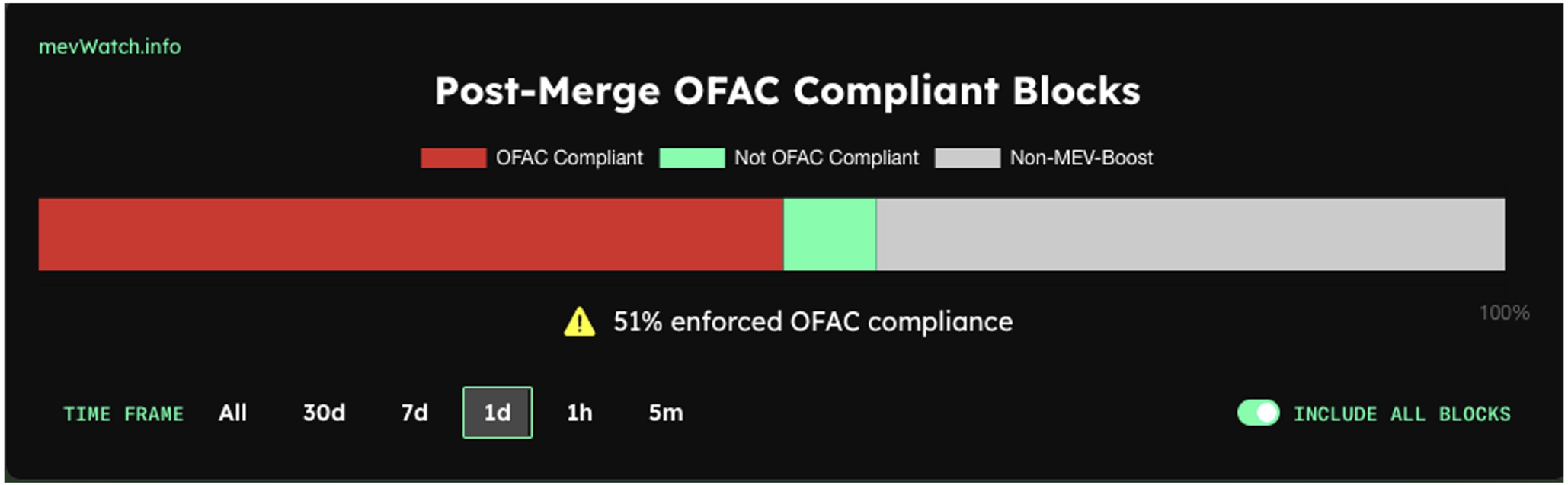
The Problem Tornado Cash Raises About Base Layer Censorship on Ethereum

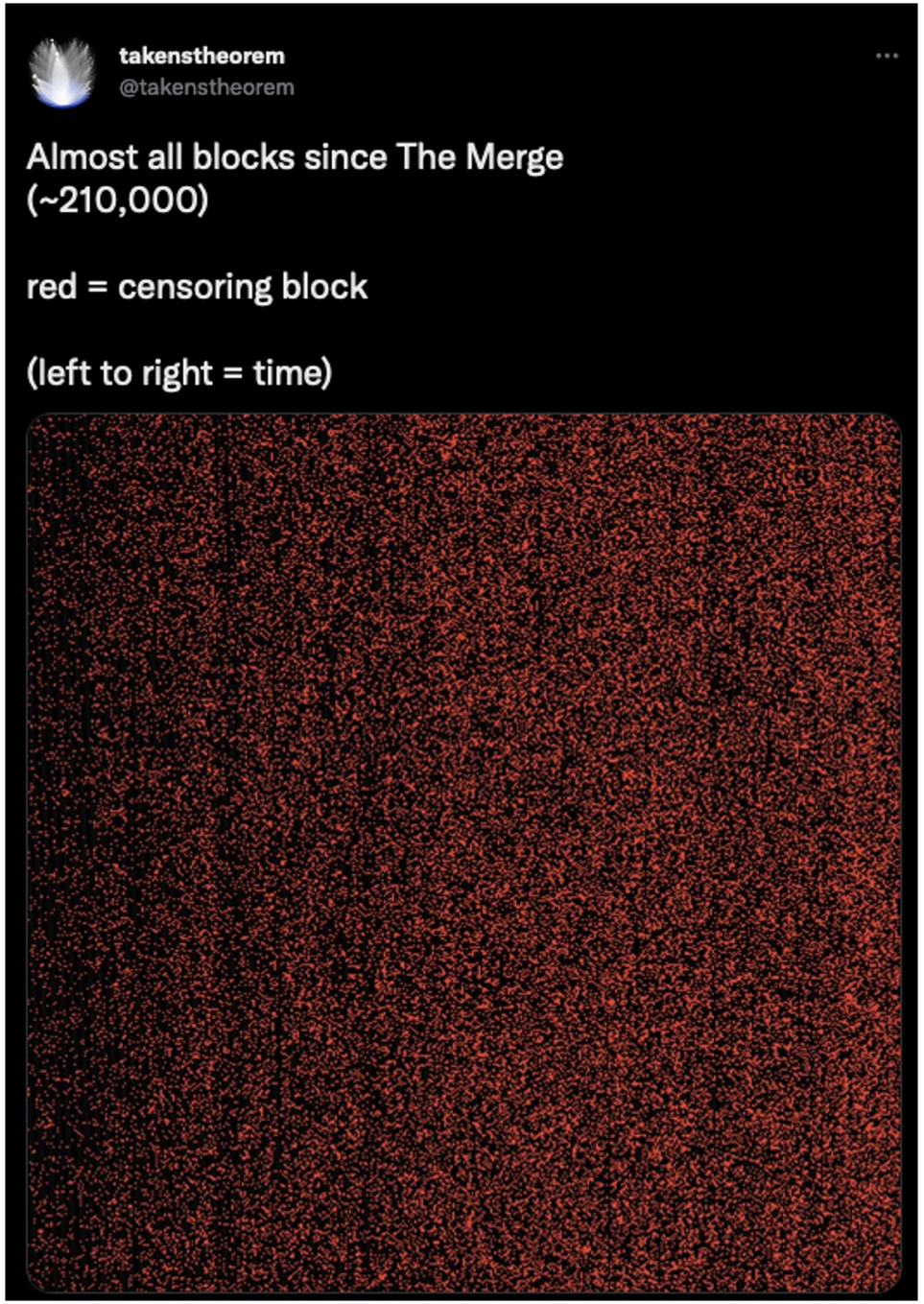
Requiring validators and others to censor blocks would be an unwarranted expansion of sanctions law.

“Show me the incentives, I’ll show you the outcome…”



Flashbots MEV-Boost: >51% blocks created by OFAC compliant validators. Why? Profit.




takenstheorem
@takenstheorem
Almost all blocks since The Merge
(~210,000)
red = censoring block
(left to right = time)

Wrap

- Flashbots is working on a new decentralized marketplace for relays announced last week at Devcon called “Suave.”
- Ethereum miners are likely to trash hardware on secondary markets.

AGENDA

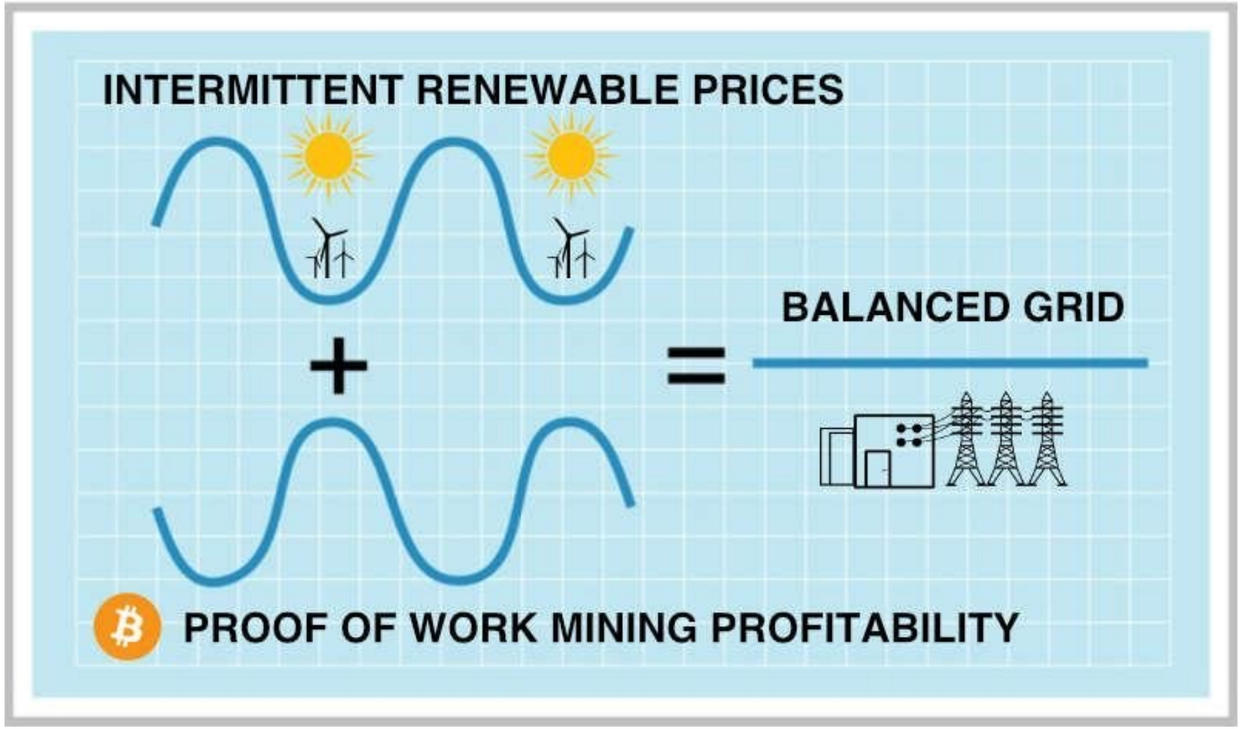
1. Introduction: Michael Saylor
2. Full BMC Q3 2022 Update: Ben Gagnon
3. Impact of Ethereum Merge: Will Foxley
4. Grid Stabilization Initiatives: Romain Nouzareth
5. Q & A

Bitcoin Mining Council

Bitcoin Mining - CURTAILMENT - Benefits

The only tech solution that can:

- **Stop on Demand**
- **Grid balancing with excess energy**
- **Good locally and globally**



THANK YOU

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