Bitcoin's Energy Usage



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Why do savers choose Bitcoin for their wealth?

TABLE 1: Top 20 most crypto-active countries - Chainalysis Global Crypto Adoption Index					
RANK	COUNTRY	OVERALL INDEX RANKING ¹	RANK	COUNTRY	CRYPTO ADOPTION INDEX ¹
1	Vietnam	1.00	11	Colombia	0.19
2	India	0.37	12	Thailand	0.17
3	Pakistan	0.36	13	China	0.16
4	Ukraine	0.29	14	Brazil	0.16
5	Kenya	0.28	15	Philippines	0.16
6	Nigeria	0.26	16	South Africa	0.14
7	Venezuela	0.25	17	Ghana	0.14
8	United States	0.22	18	Russia	0.14
9	Тодо	0.19	19	Tanzania	0.13
10	Argentina	0.19	20	Afghanistan	0.13

Source: Chainalysis 2021 <u>Global Crypto Adoption Index</u>, <u>Bitcoin Net Zero (</u>NYDIG)



Why do savers choose Bitcoin for their wealth? Cont.





Savers choose bitcoin because it offers a sound alternative system of property rights!

Key socioeconomic statistics of top 10 crypto-active countries versus global average

Source: Chainalysis 2021 <u>Global Crypto Adoption Index</u>, Heritage.org, <u>Bitcoin Net Zero (NYDIG)</u>



Why does Bitcoin consume energy, again?

To, in a decentralized manner, ensure the orderly linear history of the ledger

The ledger stores value worth ~\$800B An estimated 71m individuals hold some wealth in Bitcoin (Jan. 2021)1

At peak, it settles \$20b in transactions per day

To trustlessly and without an intermediary, distribute the new units of the synthetic commodity to the world

Miners earn a thin margin producing new units of bitcoin – there are no 'insiders' in the system There is no alternative way to distribute BTC without creating a privileged class of insiders



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Proof of Work gives Bitcoin its security and reliability



The ledger costliness is what links the digital database to the physical world and gives it weight and substance

Like clay tablets drying in the sun, energy input gives bitcoin its hardness and immutability – giving users confidence that transactions will settle



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Proof of Stake and other privileged validator-type 'fixes' to the energy consumption question just return us to the pre-bitcoin status quo







Source: Bitcoin Net Zero, NYDIG

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Where does Bitcoin mining currently stand?

Bitcoin mining accounts for 50-100 TWh of energy consumption on an annualized basis

Its 2020 consumption is equivalent to **0.04 percent** of global primary energy consumption and **0.2 percent** of global electricity generation

CHART 15: Energy consumption of Bitcoin mining versus other innovations TWh, 2020



Converted number of barrels of oil consumed per year in aviation and marine transport to TWh.

Includes consumption for OECD, China and India at an average of 375 kWh/year per unit.

Sources: IEA Future of Cooling, Global Lighting Challenge, BP Global Energy Outlook 2020, Barthel (2012), Clean Energy Resource Streams, NYDIG analysis

Source: Bitcoin Net Zero, NYDIG

Where does Bitcoin mining currently stand? Cont.

Bitcoin's power consumption is exceeded by quotidian sources like domestic tumble driers or domestic refrigeration.

These innovations add to our quality of life so their energy consumption is not questioned.





CHART 16: Carbon emissions of Bitcoin mining versus major mined products and steel production MtCO₂e, 2020



Sources: London Metal Exchange, Coindesk, Fitch, NYDIG analysis

Source: Bitcoin Net Zero, NYDIG

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Where does Bitcoin mining currently stand? Cont.

The Bitcoin mining industry accounts for relatively few emissions compared with major precious and industrial metals

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CHART 21: Historical and projected¹ Bitcoin electricity consumption as a percentage of global primary energy consumption %, 2009 - 2040



1. Based on 2020 IEA Sustainable Development Scenario; 2021 electricity consumption value based on annualized July 2021 data. Source: NYDIG analysis

Source: Bitcoin Net Zero, NYDIG

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Where does Bitcoin mining currently stand? Cont.

We find that, even reaching gold parity, Bitcoin only likely accounts for 0.4% of global energy consumption.

Assumptions: fees reach 150 BTC/day; long term electricity price of 5c/kwh, miners spend 50% of revenue on electricity, miners are 60% based in low carbon markets. 'High price' assumes \$595k/coin in 2040; 'Medium price' assumes \$300k/coin by 2040



CHART 3A: Real GDP per capita and primary energy consumption per capita by country USD per capita, MWh per capita, 2018



Sources: US Energy Information Administration, The World Bank, NYDIG analysis

Source: Bitcoin Net Zero, NYDIG

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Luxembourg

Bermuda

No one will willingly return to a pre-industrial standard of living

'Degrowth' is not an option



To manage our climate impact with without compromising quality of life, we need abundant, low-carbon energy...

...and Bitcoin (sort of) fixes this.

Miners are remarkably flexible

The seasonal 'hashrate migration' between hydro-based and coal-based markets in China exemplifies miners' willingness to seek out stranded assets





Miners relentlessly optimize for cheap, stranded, or curtailed energy







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Bitcoin mining is *fully synthetic* and can be rendered as green as its inputs

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Gold mining, for instance, cannot ever be fully green as it relies on the physical sifting of ore

Bitcoin mining can be rendered completely green if miners are able to secure exclusively sustainable power







Miners can benefit from the longterm greening of the grid, as carbon intensity declines with time



Bitcoin's energy consumption is highly flexible and location-independent

This is unlike most other energy consumers where generation must be collocated with load, limiting the permissible set of energy inputs

Location independence means that Bitcoin can exploit otherwise untapped sources of energy, especially sustainable and nonrival ones

- + Excess hydro
- + Wind and solar
- + Otherwise-flared natural gas
- + New energy assets awaiting grid connection



Flared gas mining in Canada. Photo courtesy of Upstream Data

Bitcoin mining synergizes with renewables

- Bitcoin mining improves the financial profile of new renewable energy projects
- Mining can act as an offtake before installations are fully grid-connected
- Miners are 'interruptible load' and can participate in demand response programs, stabilizing grids





Bitcoin mining, paired with battery storage, makes solar more viable at a higher capacity factor





Stronghold Digital Mining Raises \$105M to Turn Waste

The mining firm has a power plant in remote Kennerdell, Pa., using an alternative energy

Industrial waste

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Miners are exploiting stranded assets and bringing onboard new ones



Further reading











CoinShares

Aker, Seetee Shareholder Letter

Brett Winton, Solar + Battery + Bitcoin Mining

Lyn Alden, <u>Bitcoin's Energy Usage Isn't a Problem. Here's Why</u>

On Bitcoin's Energy Consumption: A Quantitative Approach to a Subjective Question

Nic Carter and Ross Stevens, Bitcoin Net Zero

Chris Bendiksen, A Closer Look at the Environmental Impact of Bitcoin Mining



Thank you!

