



# The Environmental Impact of Bitcoin

Bitcoinology London – 5 June 2024



## Why should you care?

1. If you care about the environment
2. To convince friends and family
3. Because it's an attack vector on bitcoin



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## Mining the environment – is climate risk priced into cry...

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### Mining the environment – is climate risk priced into crypto-assets?


Prepared by Isabella Gschossmann, Anton van der Kraaij<sup>[1]</sup>, Pierre-Loïc Benoit and Emmanuel Rocher<sup>[2], [3]</sup>

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# EU Moves to Ban Bitcoin to Meet Energy Goals – Report

cryptonews.com • 31 January 2024 23:41, UTC



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## Technology

# US government wants to tax bitcoin to reduce its environmental impact

The computers that secure cryptocurrencies like bitcoin consume large amounts of power, pushing up electricity prices and potentially contributing to climate change. Now, the US government wants to tackle the problem

By [Matthew Sparkes](#)

📅 12 March 2024

## Mining for Power

### Connection Between Bitcoin Miners, Corporate Interests, and Climate Deniers

🔗



## Bitcoin mining: a computationally intensive process

- **Purpose:** Verify and add new transactions to the Bitcoin blockchain.
- **Process:** Miners solve cryptographic puzzles using specialized hardware.
- **Reward:** Successful miners receive newly created bitcoins and transaction fees.
- **Proof of Work:** Ensures network security by requiring computational effort.
- **Energy Use:** High electricity consumption.



A Bitcoin mine



## What are the effects of bitcoin mining?

- E-waste
- Water footprint: direct (cooling system) and indirect (electricity generation)
- Land footprint
- Noise
- **Greenhouse gas emissions**

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**How much electricity does Bitcoin use?**



# Bitcoin's electricity consumption is hard to estimate

- Bitcoin mining is distributed.
- Many miners are off-grid.
- Miners prefer to stay under the radar:
  - Intense competition for cheap power.
  - Safety of their installations.
  - Law enforcement (in countries where mining is banned).



# Bitcoin Mining on Track to Consume All of the World's Energy by 2020

Published Dec 11, 2017 at 10:07 AM EST

Updated Mar 06, 2018 at 11:13 AM EST

This difficulty led to crazy estimates



## Cambridge Centre for Alternative Finance's estimate

- Best available mainstream estimate
- Last update in August 2023 based on January 2022 data

### Electricity



Production

**29 031 TWh**

Consumption

**25 530 TWh**

Bitcoin share

 **0.59%**

### Energy



Production

**175 892 TWh**

Consumption

**169 624 TWh**

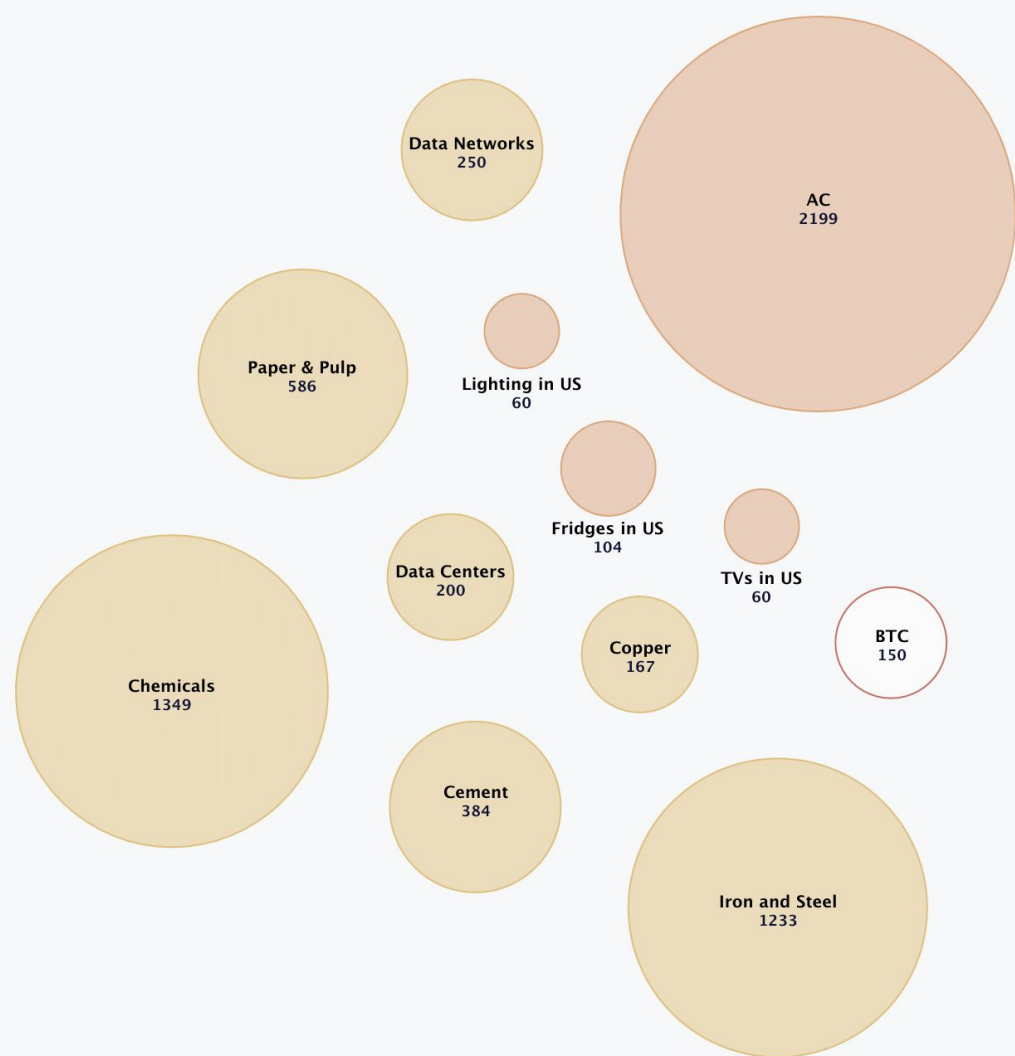
Bitcoin share\*

 **0.23%**



# Between data centers and American fridges

(CCAF, in TWh)



# Bitcoin can resist attacks from these countries

## Country Ranking

Country comparisons are, for better or for worse, the most common type of comparison. They are frequently used in the public debate to support positions of concern about the scale of Bitcoin's electricity consumption.



**Bitcoin's high energy  
consumption is a feature, not a  
bug**

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## Bitcoin energy consumption is mostly non-rival

- Miners can't pay for expensive electricity
- Miners are often located in isolated locations with low population density: West Texas, Northern Nordics, Paraguay, Arabian desert, etc.

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**What is the carbon footprint of  
Bitcoin?**

COMMENTARY

VOLUME 6, ISSUE 3, P498-502, MARCH 16, 2022

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## Revisiting Bitcoin's carbon footprint

Alex de Vries   • Ulrich Gellersdörfer • Lena Klaußen • Christian Stoll[Open Archive](#) • Published: February 25, 2022 • DOI: <https://doi.org/10.1016/j.joule.2022.02.005>

# Alex de Vries' estimate

- Methodology:
  - Similar to Cambridge, uses old data.
  - Extrapolate Co2 emissions based on the IP address of known miners and the energy mix of their countries.
  - **Conclusion: 0.2% of global emissions** (vs 4% for [air conditioning](#)!).
- About the author:
  - PHD Candidate
  - Data Scientist in the “Financial Economic Crime” division of the Netherlands' central bank



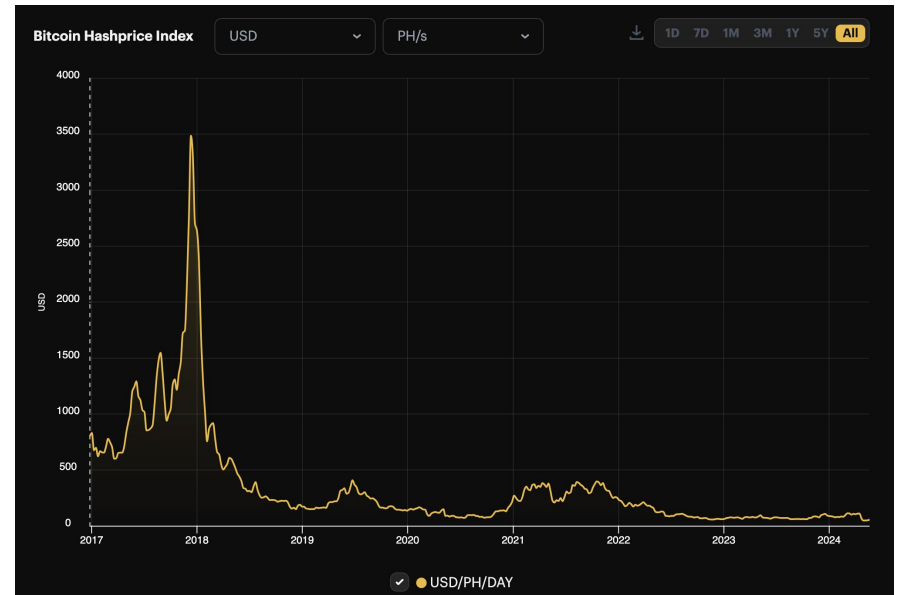


## 0.2% of global emissions: still overestimated

- Out of date
  - Jan 2022: Kazakhstan (100% fossil-fuel, hard coal) had 13% of the global hashrate, now 1%
- Do not include off-grid mining. According to Daniel Batten:
  - 28% of the global hashrate
  - 80% renewable

# Bitcoin miners are chasing cheap electricity

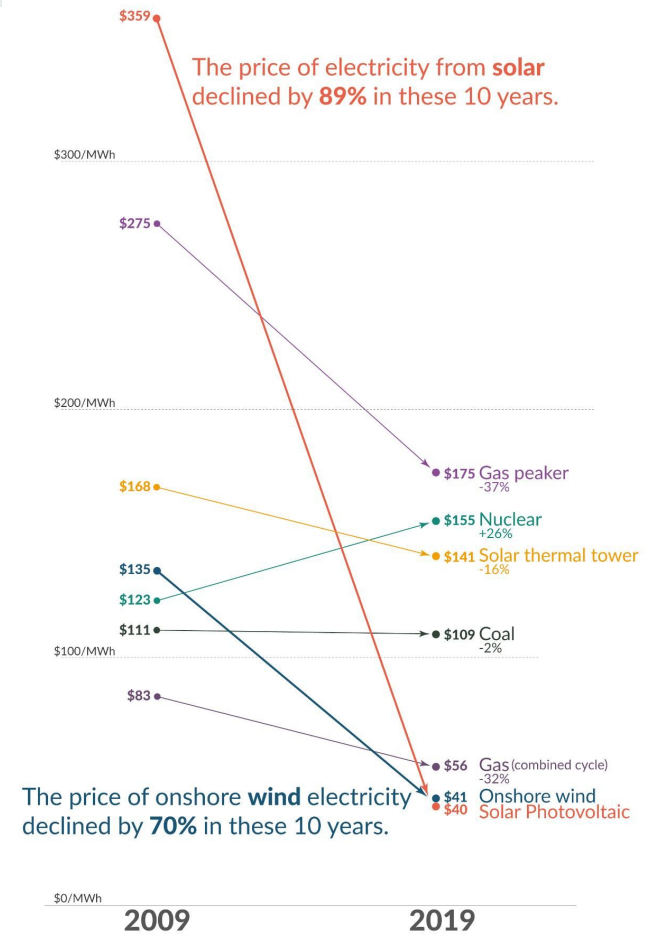
- Hashprice: dollar-denominated earnings per unit of computing power used in Bitcoin mining
- Long term decline in hashprice



The price of electricity from new power plants  
 Electricity prices are expressed in 'levelized costs of energy' (LCOE). LCOE captures the cost of building the power plant itself as well as the ongoing costs for fuel and operating the power plant over its lifetime.

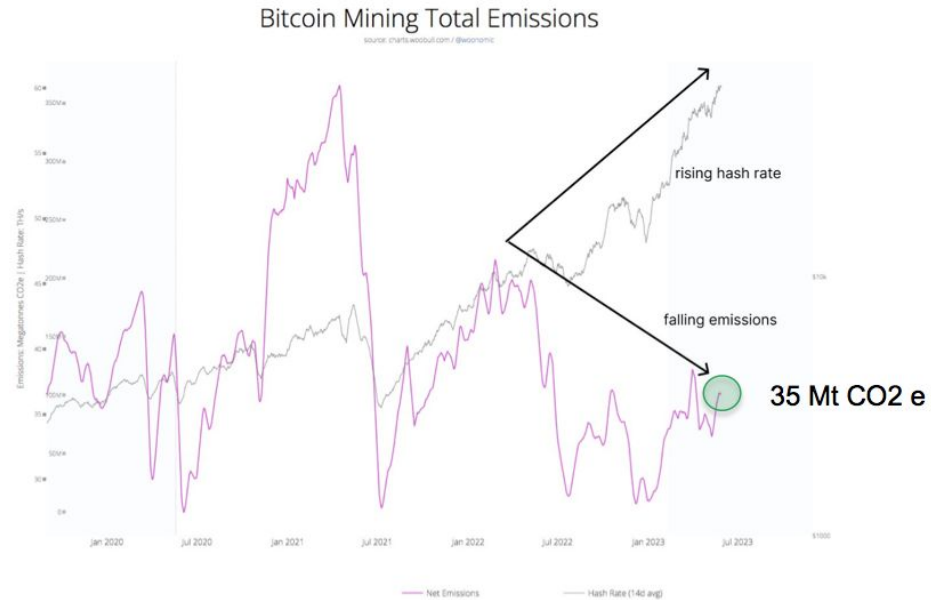
# Cheap electricity is renewable

- Wind and solar are cheaper than both new and existing fossil fuel plants ([IAE 2023](#)).
- Prices expected to fall further.
- Stranded hydro (Ethiopia, Bhutan) and geothermal (Kenya, El Salvador) also have great potential.



# Daniel Batten's estimates

- Includes offgrid mining.
- **Bitcoin's energy mix >50% sustainable**
- **Bitcoin represents 0.06% of global emissions**
- Bitcoin's emissions falling despite rise in hashrate
- Bitcoin mining is the world's leading industry user of sustainable power
- Estimates used by Bloomberg Intelligence



**Bitcoin's emissions are low and  
getting lower**

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Are there environmental *benefits*  
of Bitcoin?



# Bitcoin mining can support renewable energies

- Buyer of last resort of surplus for intermittent renewable operators.
- Demand response for oversupply and undersupply.
- Balances the electrical grid.
- Increases the profitability of renewable energy plants (during the pre-commercial phase and commercial phases).
- Accelerates the transition to sustainable energy.
- ⇒ Many US states encourage bitcoin mining with tax breaks.

Sources: [Velický 2023](#), [Bruno 2023](#), [You 2023](#), [You 2024](#)



## Bitcoin mining mitigates O&G methane emissions

- Methane is 84 times more warming than CO<sub>2</sub> (over 20 years).
- Reducing methane is the strongest lever to reduce climate change (UN 2021).
- Methane leaks from oil & gas fields.
- Capturing and storing methane is hard.
- Instead: sent to generator to create electricity to mine Bitcoin profitably.
- Converts methane to CO<sub>2</sub> before its release into the atmosphere.
- Reduces global warming by 84x.
- **BUT still fossil-fuel based.**





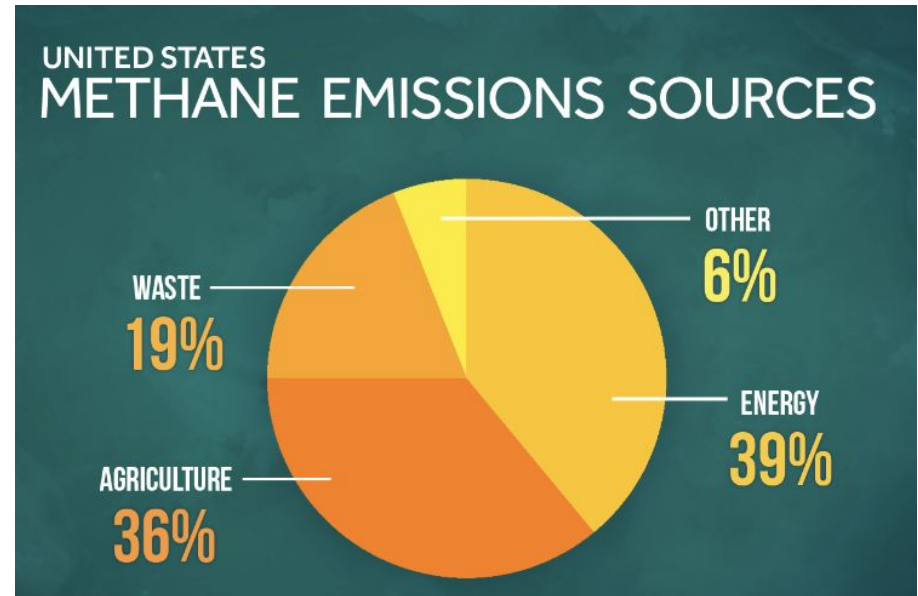
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## How Crusoe Energy Catches Waste Methane to Power Data Centres

“Data Centres”

## Bitcoin could mitigate more methane from landfills

- Landfills will be the first source of methane.
- Not profitable to generate electricity until... Bitcoin!
- Projects:
  - Marathon Digital's pilot in Utah
  - Nodal Power (startup)
- Four landfills = 4 Mt CO<sub>2</sub>e saved ⇒ 1,000x more than the largest direct air capture project ever run.



**Bitcoin can support renewable  
energies and mitigate climate  
change**



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**What about alternatives?**



## Bitcoin should be compared to its “competitors”

- Banking system: 2x more energy than Bitcoin (Galaxy Digital 2021)
- Global payment system: 0.2% of global electricity consumption (IMF 2023)
- Gold: similar electricity consumption (Cambridge 2024) but only ~10% renewable (World Gold Council 2020) ⇒ Gold mining emits ~2x more CO<sub>2</sub>. Also way more direct pollution.

### Notes:

- The above are guesstimates. And Bitcoin is not fully comparable.
- “kWh per transaction” estimates are irrelevant with batching and layer 2 (e.g. Lightning).



## What about the US dollar?

- Until 1971, fiat currencies backed by gold.
- Since then, US dollar backed by fossil fuels and the US military.
- Aka, the petrodollar system:
  - The US army protects Saudi Arabia,
  - Saudi Arabia exclusively price their oil sales in USD.

### Fossil Fuels

## The U.S. Military Emits More Carbon Dioxide Into the Atmosphere Than Entire Countries Like Denmark or Portugal

But no one knows exactly how much, because the Pentagon's reporting is spotty. A Humvee gets between four and eight miles per gallon; an F-35 requires 2.37 gallons per mile.

By Sonner Kehrt  
January 18, 2022



**Bitcoin is greener than fiat  
alternatives**

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**What about proof of stake and  
Ethereum?**



## Why not switch to proof of stake?

- Yes, proof of stake is much more energy-efficient.
- But there is no free lunch.
- Tradeoff with greater risks of centralization.



## Conclusions

- Bitcoin's high energy consumption is a feature, not a bug.
- Bitcoin's emissions are low and getting lower.
- Bitcoin can support renewable energies and mitigate climate change.
- Bitcoin is greener than fiat alternatives.

# 2030

By this date, based on current trends, Bitcoin will most likely be carbon negative and almost entirely powered by sustainable energy.

