

Proof of Work Mining Realities

Rhode Island Bitcoin Policy Initiative | March 2026

This paper compiles publicly available data on Bitcoin's proof of work mining mechanism, its energy profile, and its relationship with renewable energy and grid infrastructure. All data points are sourced from government agencies, academic institutions, and verified corporate disclosures.

52.4%

Sustainable Energy Mix

~170 TWh

Annual Consumption

0.7%

Global Electricity

99.89%

Methane Combustion (Crusoe)

1. WHAT IS PROOF OF WORK?

Proof of Work (PoW) is Bitcoin's consensus mechanism. Miners compete to solve a cryptographic puzzle, and the winner earns the right to add the next block of transactions to the blockchain, receiving a reward of newly minted Bitcoin and transaction fees. This process serves three critical functions:

- **Security:** Makes it economically infeasible to attack or rewrite the transaction history. An attacker would need to control more than 50% of global mining power, costing billions of dollars.
- **Decentralization:** Anyone with hardware and electricity can participate, preventing any single entity from controlling the network.
- **Fair issuance:** New Bitcoin is distributed through competitive work rather than arbitrary decisions, mimicking the natural scarcity of precious metals.

2. THE ENERGY PROFILE

The Cambridge Centre for Alternative Finance (CCAF) reported that **52.4% of Bitcoin mining's energy mix came from sustainable sources** as of 2025, including 42.6% renewables (primarily hydroelectric and wind) and 9.8% nuclear. This represents a dramatic shift from 2022, when sustainable energy accounted for just 37.6%, and coal's share has fallen from 36.6% to 8.9% over the same period.

Bitcoin's total electricity consumption is approximately 170-180 TWh annually (CBECI, 2026), representing roughly 0.7-0.8% of global electricity consumption. For context, residential air conditioning in the United States alone consumes approximately 500 TWh annually.

3. STRANDED ENERGY MONETIZATION

Bitcoin mining's unique properties make it one of the few industrial loads capable of monetizing "stranded" energy — resources that exist but cannot be economically utilized due to remote location or insufficient demand.

Flared Natural Gas

In 2024, approximately 151 billion cubic meters of associated gas was flared worldwide at upstream oil facilities. Crusoe Energy Systems has deployed Digital Flare Mitigation systems achieving **99.89% methane combustion efficiency**

compared to 91-92% for traditional open flares. Independent analysis by K33 Research found that mining Bitcoin with stranded natural gas reduces CO₂-equivalent emissions by approximately **63%** compared to continued flaring.

Hydroelectric Surplus

Regions like Quebec, Sichuan (China), and Scandinavia possess hydroelectric capacity that exceeds local demand during wet seasons. Bitcoin miners can consume this surplus, providing revenue to utilities that would otherwise curtail production. In British Columbia, miners purchase surplus hydro at rates below market, generating revenue for the province without displacing other consumers.

4. GRID STABILIZATION

In Texas, Bitcoin miners participate in demand response programs through ERCOT, voluntarily curtailing approximately **9,500 MW** of load during peak demand events. During Winter Storm Uri-like events, miners shut down within minutes, freeing electricity for residential heating. Riot Platforms alone earned **\$56.7 million in power curtailment credits for full-year 2025**, effectively being paid to not mine during peak demand, while stabilizing the grid for Texas consumers.

This "interruptible buyer of last resort" model is unique to Bitcoin mining. No other industrial load can ramp down to zero within minutes and resume without damage to equipment or loss of product.

5. HARDWARE EFFICIENCY

Mining hardware efficiency has improved dramatically. The standard metric is **joules per terahash (J/TH)** — the energy required per trillion hash computations. Lower values indicate greater efficiency.

Model	Hashrate	Power	Efficiency
Antminer S19 Pro (2022)	110 TH/s	3,250 W	29.5 J/TH
Antminer S19 XP (2023)	140 TH/s	3,010 W	21.5 J/TH
Antminer S21 (2024)	200 TH/s	3,550 W	17.8 J/TH
Antminer S21 XP (2025)	270 TH/s	3,645 W	13.5 J/TH

6. COMPARISON TO OTHER SYSTEMS

System	Annual Energy (TWh)	Renewable %	Can Monetize Stranded?
Bitcoin Mining	~175	52.4%	Yes
Global Banking	~500	~25%	No
Gold Mining	~265	~15%	No
U.S. Data Centers	~200	~30%	No
U.S. Air Conditioning	~500	Grid mix	No

POLICY IMPLICATIONS FOR RHODE ISLAND

- Bitcoin mining could monetize Rhode Island's offshore wind surplus during low-demand periods, creating revenue without displacing other consumers.
- Demand response programs could strengthen grid resilience during extreme weather events.
- Clear regulatory frameworks (see H.7413) could attract mining operations and the high-paying technical jobs they create.
- Environmental concerns, while valid in Bitcoin's early years, are increasingly addressed by market forces driving miners toward cheaper renewable energy.

SOURCES

¹ Cambridge Centre for Alternative Finance (CCAF), Cambridge Bitcoin Electricity Consumption Index, 2025-2026

² K33 Research, "Emissions Reduction from Flare Mitigation Mining," 2024

³ Crusoe Energy Systems, Impact Report, 2024

⁴ ERCOT Demand Response Data, 2023-2025

⁵ Riot Platforms, Inc., Annual Report 2025

⁶ International Energy Agency (IEA), Global Energy Review, 2025

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