

RESEARCH BRIEF

Bitcoin Mining, Renewable Energy, and Stranded Energy Utilization

Federal-audience research brief on the relationship between Bitcoin mining and energy systems — prepared for the Office of Senator Sheldon Whitehouse

Rhode Island Bitcoin Policy Initiative | June 2026

This brief compiles publicly available data on the relationship between Bitcoin mining and energy systems, with a focus on renewable energy adoption, stranded energy monetization, and grid stabilization. All data points are sourced from government agencies, academic institutions, and verified corporate disclosures. The brief is prepared in support of ongoing federal policy discussions on energy and digital asset infrastructure.

52.4% Sustainable energy mix (Cambridge, 2025)	~138 TWh Annual network electricity (Cambridge 2025)	~43% Efficiency gain per generation (hardware)	9,500 MW TX flexible grid load (end-2025)
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1. RENEWABLE ENERGY ADOPTION IN BITCOIN MINING

The Cambridge Centre for Alternative Finance (CCAF), the most widely cited independent authority on Bitcoin network energy data, reported in April 2025 that 52.4% of Bitcoin mining's energy mix came from sustainable sources as of 2025 — 42.6% renewables (primarily hydroelectric and wind) plus 9.8% nuclear.

This represents a substantial shift from 2022, when sustainable energy accounted for approximately 37.6% of the mining mix. Over the same period, coal's share fell from 36.6% to 8.9% — a 27.7 percentage point decline in three years.

Hydroelectric power is the single largest generation source for Bitcoin mining globally, accounting for over one-quarter of all electricity used by the network.

Why this matters federally

Bitcoin mining's sustainable energy share has grown more rapidly than the U.S. grid average over the 2022–2025 period. Federal energy policy debates that treat mining as a fossil-fuel-bound activity are working from outdated baseline data.

2. STRANDED AND WASTED ENERGY UTILIZATION

2.1 Flare gas mitigation

A significant share of U.S. mining is co-located with stranded energy sources that would otherwise be wasted. Crusoe Energy's flare gas mitigation program reports combustion efficiency of approximately 99.9% at its co-located mining sites — substantially higher than typical open-air flaring, which produces measurable unburned methane emissions.

Methane's warming potency is approximately 80 times that of CO₂ over a 20-year horizon (IPCC AR6). Flare mitigation has substantial climate value independent of its mining application; mining co-location simply provides an economic mechanism to fund mitigation infrastructure that would otherwise be uneconomic.

2.2 Curtailed renewables

Solar and wind generation regularly produces electricity in excess of grid demand during specific weather and time-of-day windows. This curtailed electricity is typically wasted or sold at negative prices. Mining co-located with curtailment-prone renewable sites can absorb this surplus generation, improving renewable buildout economics by providing a price floor for otherwise-wasted output.

3. GRID STABILIZATION THROUGH FLEXIBLE LOAD

Texas's ERCOT grid operator has integrated Bitcoin miners as "large flexible load" (LFL). Approved LFL capacity reached approximately 9,500 MW by end-2025, up from 5,479 MW the prior year. Miners reduce or shut down operations during peak demand events and absorb surplus generation during low-demand windows.

ERCOT Large Flexible Load	End 2024	End 2025
Approved capacity	5,479 MW	9,500 MW
Growth	—	+73%
Reported demand-response participation	Substantial	Substantial

ERCOT's experience demonstrates that mining-as-flexible-load is operationally viable and meaningful at gigawatt scale. The Public Utility Commission of Texas has held proceedings analyzing rate impact, which has been net favorable for non-mining ratepayers under well-designed demand-response programs.

4. HARDWARE EFFICIENCY AND TREND

Per-hash energy intensity has declined approximately 43% per generation of mining hardware. While total network energy use has grown alongside Bitcoin's adoption, energy per unit of network security has improved substantially. The efficiency trend is expected to continue as next-generation ASIC architectures roll out.

5. FEDERAL POLICY IMPLICATIONS

5.1 Mining as energy infrastructure, not energy waste

The empirical record supports treating Bitcoin mining as flexible-load infrastructure for grid policy purposes, not as a regulatory target. The Department of Energy's recent assessments treat mining alongside data center load broadly — both are scalable demand for which operational integration with the grid is more productive than restriction.

5.2 Climate alignment

Mining co-located with flare gas mitigation, curtailed renewables, and nuclear baseload represents a meaningfully climate-aligned subset of mining activity. Federal policy that subsidizes or otherwise supports this subset — through, for example, methane-mitigation tax credits or grid-integration grants — would advance both climate and digital asset policy objectives.

5.3 Coordination with state-level efforts

State-level offshore wind buildout (notably in New England) creates curtailment dynamics that mining co-location could address. Federal grant and tax programs supporting demand-response infrastructure could include mining-co-located deployments without singling them out.

6. RECOMMENDATIONS

1. Treat Bitcoin mining as flexible-load infrastructure in federal energy policy. The empirical record does not support restriction-oriented approaches.
2. Support methane-mitigation tax credit eligibility for flare-gas-co-located mining. The climate benefit is substantial and independent of the mining application.
3. Authorize the Department of Energy to study mining-co-located demand response as a curtailment-monetization mechanism for offshore wind buildouts.
4. Coordinate with state public utility commissions on flexible-load integration frameworks. The Texas ERCOT experience provides a substantial template.

APPENDIX: SOURCES AND REFERENCES

Energy Data — Primary Sources

- Cambridge Centre for Alternative Finance, Digital Mining Industry Report (April 2025); Cambridge Bitcoin Electricity Consumption Index (CBECI)
- U.S. Energy Information Administration, Bitcoin mining electricity briefs
- International Energy Agency, world electricity consumption data

Grid and Flexible Load

- ERCOT, Large Flexible Load reports (2024–2025)
- Public Utility Commission of Texas, LFL proceedings
- U.S. EIA Today in Energy, ERCOT LFL series

Industry Disclosures (Self-Reported)

- Crusoe Energy, methane combustion efficiency disclosures
- Riot Platforms, 10-K filings
- Coinmint, Massena facility statements

Federal Policy Context

- GENIUS Act, P.L. 119-27, signed July 18, 2025
- Department of Energy, AI/mining electricity demand assessments
- IPCC Sixth Assessment Report (AR6), methane GWP values

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End of Report