WHITE PAPER · GAS UTILIZATION · OCTOBER 2026

Wellsite Bitcoin Mining Makes Money Every Month. It Can Still Lose $589,000.

A transparent five-year model of a 1 MW pad installation clears $335,251 of operating cash in its first year and still returns a negative net present value. For operators in Kansas, Oklahoma and Texas, the gap between those two numbers decides whether stranded gas becomes an asset or an expensive lesson.

Gas-to-Bitcoin at Mature Oil and Gas Pads: Profitability, Diversification, and the Conditions for Lower Risk

$335K	−$589K	$54.73	240
YEAR-ONE OPERATING CONTRIBUTION	FIVE-YEAR NPV, CENTRAL CASE	HASHPRICE NEEDED TO BREAK EVEN ON CAPITAL	MCF PER DAY TO RUN ONE MEGAWATT

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October 2026 · For discussion with operators, mineral owners and capital partners

WHAT THIS PAPER FINDS

$54.73

THE HASHPRICE AN OWNED PROJECT NEEDS

Operating break-even in the central case is $17.36 per PH/s per day. Recovering the $1.25 million of capital at a 10% return takes $54.73. Clearing the first number while missing the second is the most common way a profitable-looking site destroys value.

$124K

THE YEARLY COST OF GAS THAT ISN'T REALLY FREE

If the gas could otherwise be sold for $1.50 per MMBtu, diverting it to mining costs $124,173 a year in foregone value. At $3.00 the first-year operating margin falls from $335,251 to $86,905. 'No pipeline' is not the same as 'no value'.

+$362K

A CONTRACT THAT LOOKS GREAT TO ONLY ONE SIDE

A fixed gas-and-site agreement shows the producer a positive $362,180 NPV while the miner on the other side loses $989,509. A producer counting those payments as secure is counting on a counterparty that is modeled to lose money.

+13%

MORE DOLLAR SWING, NOT LESS

Adding an uncorrelated mining stream to a pad raised the combined monthly standard deviation from $15,000 to $17,000 in a simple illustration, even as volatility relative to cash flow fell. 'Diversified' and 'less risky' are different claims.

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EXECUTIVE SUMMARY

Operators across the Midcontinent are being offered a simple pitch: take gas that has no good market, burn it in a generator on the pad, and point the electricity at Bitcoin mining computers. The gas earns money instead of being flared or shut in, and the pad picks up a third revenue stream that does not move with oil. This paper tests that pitch with a transparent financial model, a review of the published research, and a field-validation design that an operator could actually run.

The answer is conditional. Converting low-value gas into mining receipts can raise the value of selected mature assets, especially where the gas has little alternative use and the equipment can be sized correctly and moved when the gas runs down. But the central model case shows how easily a project that is profitable every month can still fail as an investment: a 1 MW installation clears $335,251 of operating contribution in its first year and still returns a five-year net present value of negative $589,421 once gas decline, falling mining revenue, equipment replacement and the cost of capital are counted.

Three findings carry the argument. First, operating break-even and investment break-even are far apart — $17.36 versus $54.73 per PH/s per day in the central case — and sellers routinely quote the first. Second, the alternative value of the gas is the single largest lever on the result: at $3.00 per MMBtu, even a $60 starting hashprice produces a negative NPV. Third, third-party contracts move risk rather than remove it. A fixed-price agreement that looks excellent to the producer can be ruinous for the miner paying it, and a payment stream is only as good as the party making it.

Low correlation between Bitcoin and oil does not make mining a hedge. Adding an independent cash stream to a pad increases the total dollar swing unless the two move against each other strongly enough. Mining can improve expected cash flow and reduce dependence on oil prices; whether it reduces the chance of a cash shortfall is a separate question that has to be measured, not assumed.

The near-term opportunity for Heartland Tech AI is decision support rather than promotion: screen which wells and clusters have gas worth using, compare mining against every other use of that gas on consistent economics, model both sides of any contract, and reconcile metered gas to electricity to accepted hashrate to dollars in the bank.

1 THE QUESTION OPERATORS ARE ACTUALLY ASKING

1.1 The proposition

The research question is narrow on purpose: under what physical, contractual and financial conditions does wellsite Bitcoin mining increase the economic value of a mature oil and gas asset while reducing a clearly defined downside risk? The unit of analysis is the pad, or an economically connected cluster of wells, not Bitcoin as a financial asset. An operator does not care whether Bitcoin is a good investment in the abstract. The operator cares whether this generator, on this gas, on this lease, earns back what it costs and leaves the business sturdier than before.

That framing excludes a common shortcut. A third revenue driver is not necessarily a third independent business. Mining usually replaces the sale, use or disposal of the same gas stream that comes up with the oil. Its incremental contribution must be calculated after the value of whatever the gas would otherwise have done, and after every new cost it brings.

1.2 Scope and evidence standard

The analysis compares an unchanged pad with several alternatives: operator-owned mining, a third party buying the gas, third-party hosting or revenue sharing, and keeping the gas in its best non-mining use. Pipeline sale, field-power displacement, gas processing, compression and transport, lawful flaring where permitted, and shut-in are each different counterfactuals with different economics. The baseline cannot be chosen because it flatters mining.

Evidence is held to four standards. Published research is used for mechanisms and methods under its authors' stated assumptions, not as current investment guidance. Government technical material is used for equipment behavior and public-data boundaries, not as a current bid. Trade reporting documents configurations and commercial structures, not verified returns. Original calculations demonstrate relationships, not field performance. The reviewed sources do not contain a matched, audited panel of mining and non-mining pads, so this paper does not claim to have measured a reduction in pad-level risk.

2 HOW GAS BECOMES BITCOIN REVENUE

2.1 What the business sells

The producer controls a physical gas stream. A mining installation burns part of it in an engine-generator and converts the electricity into computational work that earns Bitcoin-denominated rewards from a mining pool. Trade reporting from the industry's early years describes self-contained skids that bundle the generator, the mining computers and a shelter for both, sized for engines from roughly 45 kW up to 1.2 MW, and dropped onto sites where gas has no pipeline outlet.[1]

The commercial question is not whether gas can run a generator. It plainly can. The question is which party receives each revenue stream and which bears each cost. The same reporting describes three arrangements: the producer buys the equipment and keeps the mining profit; the producer supplies gas and power while the equipment provider takes a profit share; or the provider places its own skid on site in exchange for free gas.[2]

Larger producers have also supplied gas to mining operations owned and run by a third party. In 2022 ConocoPhillips began supplying Bakken gas that would otherwise have been flared to a third-party mining pilot, the first such arrangement reported for a major U.S. producer.[3]

[1] Bitcoin Magazine, "Oil Field Alchemy: How Bitcoin Can Turn Waste, Emissions into Proof-of-Work", C. Harper, 8 May 2019.
[2] Bitcoin Magazine, "Oil Field Alchemy".
[3] World Oil, "ConocoPhillips supplying a Bitcoin miner with gas from Bakken", Bloomberg wire, 16 February 2022.

2.2 Why "Bitcoin price" is the wrong revenue assumption

Mining revenue is not set by Bitcoin's price alone. The industry measures it as hashprice: revenue per unit of computing capacity per day, usually quoted in dollars per petahash per second per day (PH/s/day). Hashprice moves with Bitcoin's price, but also with the total computing power competing for the same rewards, the scheduled reward halvings and transaction fees. Converting hashprice into revenue per megawatt-hour depends on the efficiency of the mining fleet, measured in joules per terahash (J/TH).[4]

This matters for underwriting. A model that raises revenue with Bitcoin's price while holding network difficulty and equipment productivity permanently favorable will overstate returns, because a rising price attracts more competing machines and the revenue per machine falls. Miners themselves treat the business as volatile: the Cambridge Centre for Alternative Finance's industry survey reports firms exploring diversification specifically to find steadier, more predictable revenue.[5]

2.3 What the evidence base is — and isn't

The Cambridge survey covered 49 mining firms representing 48% of network hashrate when the data were collected, and its authors caution that unusually strong U.S. participation probably overstates the U.S. share of the sample. It is a survey of mining companies, not a census of oilfield installations.[6]

No source reviewed supplies an audited, market-wide return series for gas-to-mining sites. This paper therefore assigns no industry-average return, penetration rate or guaranteed payback. Current vendor quotes and site records must replace the illustrative assumptions in Section 6 before any capital is committed.

3 WHAT THE RESEARCH SUPPORTS — AND WHAT IT DOESN'T

3.1 Technical feasibility does not validate payback claims

Snytnikov and Potemkin's 2022 iScience paper proposes an integrated system in which flared associated gas is conditioned by low-temperature steam reforming, burned in engines or turbines to power on-site mining, with carbon dioxide captured and reinjected. The paper is a technical proposal: it describes the integration and calls the approach economically attractive without presenting a full cost, payback or sensitivity analysis of the integrated business.[7]

The EPA's technology characterization of reciprocating engines explains why operating costs cannot be assumed away. It sets out maintenance labor, consumables such as oil, filters and spark plugs, and minor and major overhauls, and it shows spark-ignition engine efficiency falling as load drops — by roughly 8 to 10 percentage points at half load.[8]

[4] Hashrate Index (Luxor Technology), "Energy-Adjusted Hashprice: Bitcoin Mining Revenue in Energy Terms", B. Harper and K. Farahani, 23 December 2024.
[5] Cambridge Centre for Alternative Finance, *Cambridge Digital Mining Industry Report: Global Operations, Sentiment, and Energy Use*, University of Cambridge Judge Business School, 2025.
[6] Cambridge Centre for Alternative Finance, *Cambridge Digital Mining Industry Report.*
[7] Snytnikov, P., and D. Potemkin, "Flare Gas Monetization and Greener Hydrogen Production via Combination with Cryptocurrency Mining and Carbon Dioxide Capture", iScience 25(2): 103 769, 2022.
[8] U.S. Environmental Protection Agency, *Catalog of CHP Technologies, Section 2. Technology Characterization – Reciprocating Internal Combustion Engines*, Combined Heat and Power Partnership, March 2015.

Read together, these sources support the technical pathway but not the transfer of an optimistic historical payback into a mature-well investment model. The model in this paper charges for generation operations and maintenance, engine overhaul and ongoing site costs explicitly.

3.2 A positive operating margin is not a good investment

Jabłczyńska and co-authors' 2023 PLOS ONE study evaluates mining profitability under December 2021 market conditions and identifies the fast and unpredictable rise in network difficulty as the main reason mining proves unprofitable. Its base case amortizes hardware over twelve months and tests sensitivity to assumptions including machine price.[9]

This paper adopts the study's central distinction without importing its numbers. A generator and miners may produce positive operating cash after installation while failing to recover their purchase price and required return. Conversely, a project with a poor new-build return may still be worth running temporarily once its capital is sunk, provided running beats shutting down or selling the equipment.

3.3 Market diversification is not pad diversification

Attarzadeh and Balcilar analyze daily data from November 2013 through September 2021 using a time-varying vector autoregression and find that connectedness between Bitcoin and other markets, including crude oil, strengthens substantially during crises such as the 2018 cryptocurrency crash and the COVID-19 pandemic.[10]

The lesson is to test dependence across market regimes rather than assume a permanent hedge. The study does not model well-site gas, generator costs or mining cash flow, and it cannot be cited as evidence that installing miners cuts a pad's cash-flow variance by any particular percentage.

3.4 Evidence assessment

Evidence	What it supports	What it does not establish
Integrated gas-to-mining proposal (iScience)	Technical integration; need to condition variable gas	Present-day costs, audited returns or payback
Mining economics (PLOS ONE)	Operating vs. investment profitability; difficulty and capital sensitivity	A universal current break-even price
Market connectedness study	Dependence changes over time and rises in stress	Pad-level causality or mining-margin correlation
Cambridge industry survey	Industry context; pressure on mining revenue	A return distribution for mature-well sites
Trade reporting on skids and contracts	Configurations and ownership structures exist	Independently verified project returns
EPA engine characterization	Maintenance categories; part-load efficiency loss	Current equipment bids

[9] Jabłczyńska, M., et al., "Energy and cost efficiency of Bitcoin mining endeavor", PLOS ONE 18(3): e0 283 687, 2023.
[10] Attarzadeh, A., and M. Balcilar, "On the dynamic return and volatility connectedness of cryptocurrency, crude oil, clean energy, and stock markets: a time-varying analysis", Environmental Science and Pollution Research 29: 65 185–65 196, 2022.

Sources: Snytnikov, P., and D. Potemkin; Jabłczyńska, M., et al.; Attarzadeh, A., and M. Balcilar; Cambridge Centre for Alternative Finance; Bitcoin Magazine; U.S. Environmental Protection Agency.[11]

4 WHAT "LOWER PAD RISK" HAS TO MEAN

4.1 The arithmetic most pitches skip

Let B be the pad's baseline cash flow and M the genuinely incremental mining contribution after displaced gas value and new costs. The combined cash flow is B + M, and its variance is Var(B) + Var(M) + 2·Cov(B, M). That is an identity, not an assumption.

Total dollar variance therefore falls only when 2·Cov(B, M) is more negative than −Var(M) — equivalently, when the correlation between the two is below −σM / (2σB). If mining is merely uncorrelated with the pad and has any volatility of its own, the total dollar swing goes up. Mining may still raise expected profit, reduce the share of revenue tied to oil, reduce volatility relative to average cash flow, or lower the probability of a negative month. Each of those is a separate outcome that must be measured separately rather than bundled into the word "de-risking."

A simple illustration makes the point. Suppose a pad's monthly cash flow averages $20,000 with a standard deviation of $15,000, and independent mining adds an average of $10,000 with a standard deviation of $8,000. The combined standard deviation is $17,000 — higher than before — while the standard deviation as a share of the mean falls from 75% to about 57%. Means and standard deviations alone do not give a default probability; that also requires the shape of the distribution, available liquidity and payment obligations.

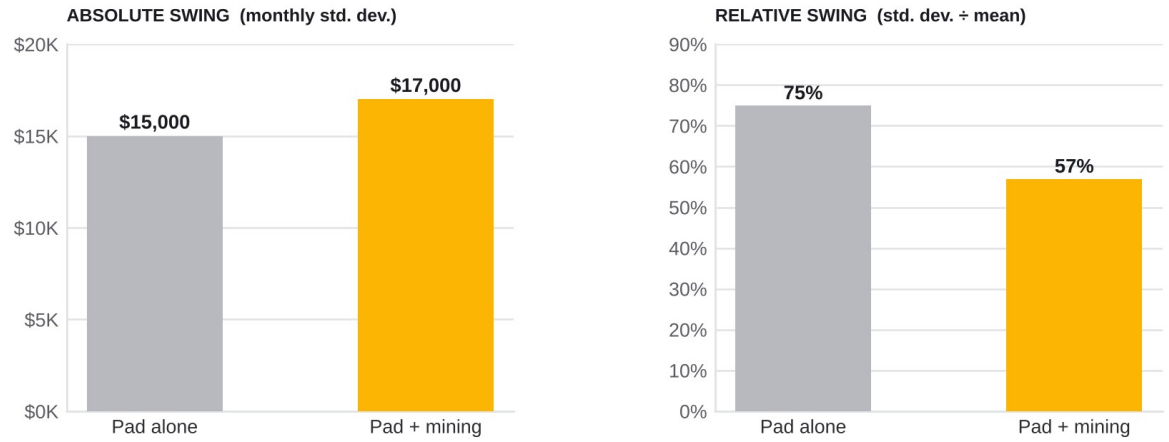

FIGURE 1 The same illustrative pad, before and after adding an independent mining stream. Dollar volatility rises from $15,000 to $17,000 a month while volatility relative to average cash flow falls from 75% to 57%. Illustrative values, not field data.

4.2 Physical and contractual dependence

Mining stays physically linked to the oil business even when it is paid in a different asset. If a production outage removes associated gas, or falling oil prices lead the operator to shut in the supplying wells, the

[11] Snytnikov, P., and D. Potemkin, "Flare Gas Monetization"; Jabłczyńska, M., et al., "Energy and cost efficiency of Bitcoin mining endeavor"; Attarzadeh, A., and M. Balcilar, "On the dynamic return and volatility connectedness"; Cambridge Centre for Alternative Finance, *Cambridge Digital Mining Industry Report*; Bitcoin Magazine, "Oil Field Alchemy"; U.S. Environmental Protection Agency, *Catalog of CHP Technologies, Section 2.*

miners lose fuel at the same moment the pad loses oil revenue. Gas opportunity cost creates a second link: where gas has a reachable market, a higher gas price makes diverting it to mining more expensive. Where gas is genuinely stranded, that link may be weak — and a local constraint can matter more than any national benchmark.

4.3 An underwriting dashboard that keeps the claims apart

Outcome	Recommended definition	What it tells the owner
Investment value	Incremental NPV vs. best feasible alternative	Whether the project creates value
Cash resilience	Probability and duration of negative free cash flow	Whether emergency funding is less likely
Severe downside	Average loss in the worst 5% of outcomes	Whether extreme losses improve
Absolute volatility	Std. dev. of monthly dollar cash flow	Whether dollar swings actually shrink
Relative volatility	Std. dev. ÷ mean, where meaningful	Whether cash flow steadies relative to size
Debt protection	Probability of breaching the actual covenant	Whether lenders get stronger coverage
Commodity concentration	Sensitivity to oil and local gas prices	Whether the business depends less on them

Proposed measurement definitions, not reported improvements.

5 AN EXPLORATORY MARKET CHECK

The underlying analysis for this paper aligned monthly closing prices for benchmark Bitcoin, crude oil and natural gas series, converted them to month-over-month returns, and covered February 2020 through September 2026. The benchmark series are not realized Kansas, Oklahoma or Texas wellhead prices, their contract-roll construction was not documented, and a weekend cryptocurrency close is not exactly simultaneous with a commodity close. The exercise is a price-proxy check, not a mining cash-flow study.

Pair	Monthly return correlation	Exploratory 95% interval
Bitcoin / crude oil	0.162	−0.023 to 0.343
Bitcoin / natural gas	−0.037	−0.265 to 0.193
Crude oil / natural gas	−0.014	−0.136 to 0.143

Intervals from a circular moving-block bootstrap (three-month blocks, 5,000 resamples, fixed seed). Computed in the underlying analysis; benchmark data not re-run for this edition.

The Bitcoin–crude correlation falls from 0.234 in February 2020 to December 2022 to 0.021 from January 2023 to September 2026; Bitcoin–natural gas moves from 0.060 to −0.166 over the same split. Those shifts

reinforce the decision not to assume a single permanent dependence parameter. The variable that matters is realized net mining contribution, not Bitcoin's price, because hashprice and fleet efficiency set mining receipts and gas opportunity cost sets part of the expense. No simulated default probability or percentage reduction in pad risk is reported here; producing one without calibrated site data would be false precision.

6 THE MODEL

6.1 Assumptions, not market quotations

The model is a deliberately transparent five-year comparison, not a feasibility study of an identified pad. Every input is chosen for sensitivity testing rather than asserted to be typical. The same physical plant is used across ownership structures so that commercial allocation can be separated from engineering. The Python source, its outputs and a data dictionary are published alongside this paper so that any reader can reproduce or change every number.

Input	Assumed value	Interpretation
Generator output while operating	1,000 kW	Pad or cluster scale, not a typical single well
Non-mining electrical load	8%	Cooling and auxiliaries
Mining fleet efficiency	20 J/TH	Held constant
Effective availability	90%	Applied once to energy, fuel and revenue
Electrical heat rate (HHV)	10,500 Btu/kWh	Part-load penalty not modeled
Gas energy content	1.05 MMBtu/Mcf	Replace with measured fuel quality
Starting hashprice	$25, $40, $60 /PH/s/day	Scenarios, not quotes
Deliverable-gas decline	10% a year	Reduces dispatched capacity
Hashprice decline	10% a year	Smooth stress, not a forecast
Pool fee	2% of gross	Not double-counted
Generation O&M	$0.025 per kWh	Includes engine overhaul provision
Other operating expense	$60,000 a year	Site, service, administration
Initial investment	$1,250,000	Gas prep, generation, electrical, mining
Fleet replacement	$200,000 in year 3	Maintains, does not upgrade, efficiency
Net terminal proceeds	$100,000 in year 5	After removal; not an appraisal
Discount rate	10%	Convention, not a cost-of-capital estimate
Alternative gas netback	$0, $1.50, $3.00 /MMBtu	Opportunity cost of the gas

Unlevered and before income taxes. No royalty burden, carbon credits or held-Bitcoin appreciation included.

At full output the plant consumes 240 Mcf a day, or 216 Mcf a day averaged over the assumed availability. That is a calculated requirement, not evidence that any mature well supplies it. Treating mining fuel as royalty-free is a simplification and a major diligence item, not a conclusion.

6.2 First-year operating results

At the central $40 hashprice the plant runs 46 PH/s and earns $604,440 of gross mining revenue. After the pool fee, receipts are $592,351; generation O&M is $197,100 and other operating expense is $60,000. What remains depends on what the gas could have earned elsewhere.

Alternative gas netback	Annual foregone gas value	Year-one operating contribution
$0.00 / MMBtu	$0	$335,251
$1.50 / MMBtu	$124,173	$211,078
$3.00 / MMBtu	$248,346	$86,905

Before capital recovery, taxes, financing and any royalty burden.

6.3 Five-year results: the investment view

Gas supply and hashprice both decline in the central case, so annual cash falls even though fixed costs are held constant and the plant is assumed to shed load in efficient modules. Dividing the $1.25 million investment by the first year's contribution suggests a 3.7-year payback. That shortcut ignores the decline and the year-three replacement, and the modeled project in fact never recovers its initial investment within five years, even before discounting.

Year	Hashprice	Operating contribution	Free cash flow
0	—	—	−$1,250,000
1	$40.00	$335,251	$335,251
2	$36.00	$242,414	$242,414
3	$32.40	$168,991	−$31,009
4	$29.16	$111,114	$111,114
5	$26.24	$65,670	$165,670
Total, five-year NPV at 10%			**−$589,421**

Owner-operated, zero alternative gas value. Year 3 includes $200,000 fleet replacement; year 5 includes $100,000 net terminal proceeds.

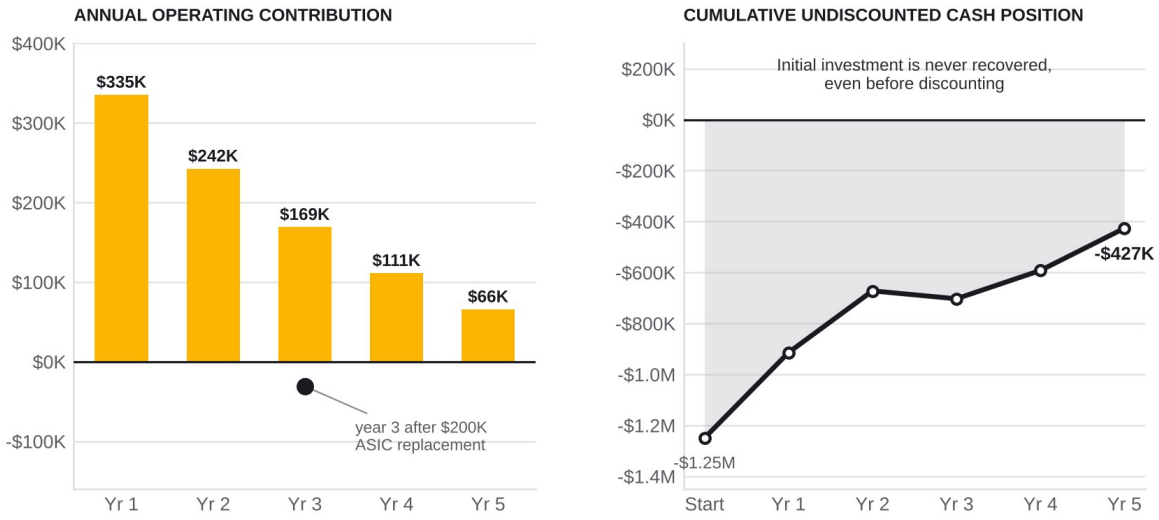

FIGURE 2 Every year is cash-positive at the operating line, yet the cumulative position ends at −$427,000 before discounting. Owner-operated central case, $40 starting hashprice, gas valued at zero.

6.4 The scenario grid

Starting hashprice	NPV, gas at $0	NPV, gas at $1.50	NPV, gas at $3.00
$25 / PH/s / day	−$1,189,558	−$1,582,784	−$1,976,010
$40 / PH/s / day	−$589,421	−$982,647	−$1,375,873
$60 / PH/s / day	$210,762	−$182,464	−$575,690

Owner-operated, five-year NPV at 10%.

The grid shows conditional viability rather than a blanket rejection. Under these assumptions the high-hashprice, genuinely stranded gas case creates value. Any real alternative value for the gas raises the hurdle sharply. An asset should not command an acquisition premium because a seller presents a positive monthly mining margin.



FIGURE 3 Only one of nine cases clears zero: a $60 starting hashprice on gas with no alternative value. Owner-operated five-year NPV at a 10% discount rate.

6.5 Operating break-even versus investment break-even

For the first-year cost structure, the operating break-even hashprice is $17.36, $25.75 and $34.13 per PH/s per day at gas netbacks of $0, $1.50 and $3.00. Those thresholds cover operating costs only. The starting hashprice that produces a zero five-year NPV for the owner-operated case, with gas valued at zero, is $54.73. “It runs above break-even” is a far weaker claim than “it should be bought as a new investment.” These thresholds are specific to this model and should not be quoted as industry break-evens.

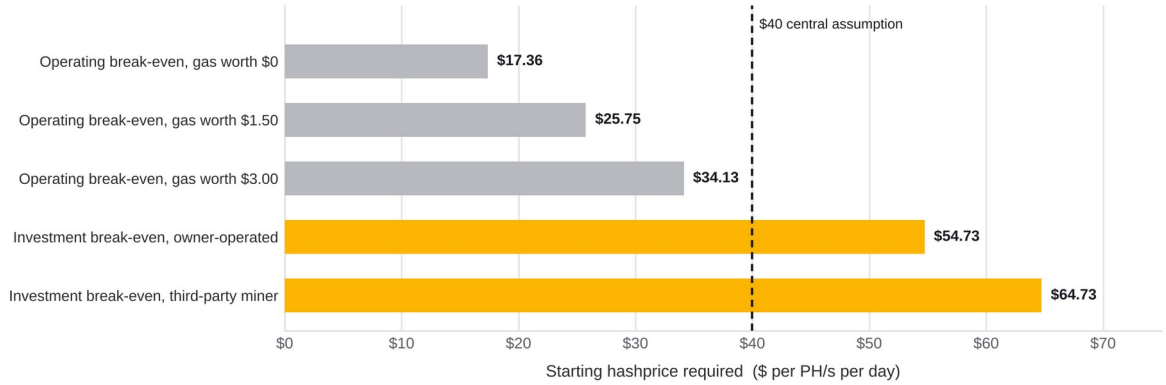

FIGURE 4 At the central $40 assumption the plant clears every operating break-even and misses both investment break-evens. Starting hashprice required, $ per PH/s per day.

6.6 Decline sensitivity

Holding the $40 start and zero gas value, and changing only the two decline rates, isolates how much of the loss comes from a shrinking resource and a shrinking reward. Even with no decline in either, the project falls just short of recovering its capital at 10%.

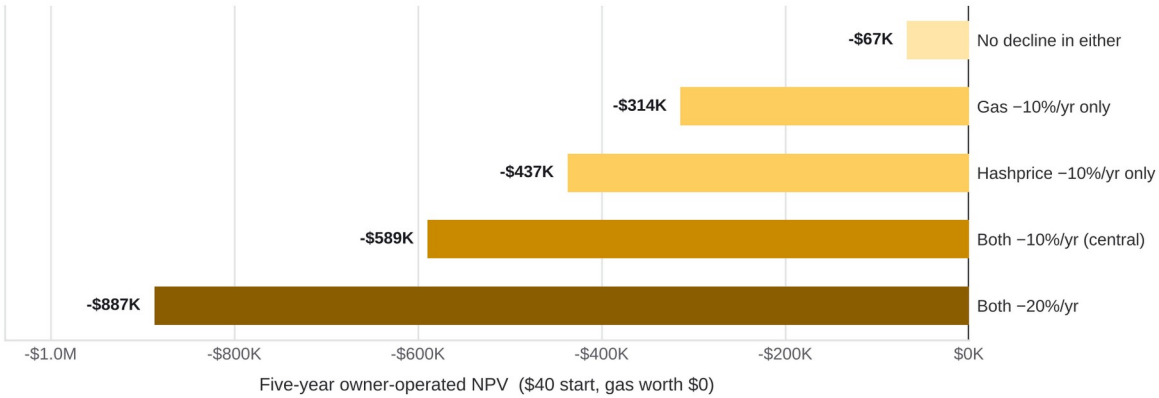

FIGURE 5 Five-year owner-operated NPV as gas and hashprice decline rates change. All other inputs fixed. These are sensitivities, not probabilities.

The model does not simulate halving dates, a changing network response or optimized hardware upgrades, and it runs on a predetermined schedule rather than an optimized shutdown policy. A smooth decline should be replaced by calibrated paths or discrete stress events for underwriting, without adding a halving shock to a forecast that already includes it.

7 WHO ACTUALLY BEARS THE RISK

7.1 Ownership and contract structures

The taxonomy below is analytical, not a description of standardized contracts. Real agreements must be mapped by cash flow, asset ownership, operating responsibility, termination rights and liability.

Structure	Producer receives	Main advantage	Main vulnerability
Operator owns everything	Mining receipts after pool fees	Full upside and dispatch control	Full capital and operating risk
Third party buys gas, fixed price	Payment for metered gas	Sheds mining-price and hardware risk	Fixed price is not guaranteed volume or payment
Third party buys gas, indexed	Commodity-linked gas receipts	Simple energy monetization	Less independent of gas prices
Producer sells power; partner owns miners	Power or hosting receipts	Separates computing from energy	Producer may keep the hardest obligations
Revenue or profit share	Share of mining outcome	Upside without owning all equipment	‘Profit’ can shrink through cost allocation
Floor plus upside	Minimum payment plus participation	Downside support with upside	Floor may vanish exactly when needed

Analytical taxonomy, not standardized contract forms.

A fixed gas price changes price exposure, not the fact that gas must be produced and accepted. Take-or-pay terms, collateral, parent guarantees, termination payments, insurance and step-in rights can improve

protection, but only to the extent they are enforceable and the counterparty can pay. A contract cannot manufacture project profit; it only divides it. Selling mined Bitcoin promptly for operating cash is also different from holding it; any treasury-holding policy is a separate exposure with its own liquidity and custody controls.

7.2 An illustrative fixed-price agreement

Assume the producer contributes $50,000 for the tie-in, the miner funds the other $1.2 million, the miner pays $1.50 per MMBtu for gas burned and $15,000 a year for the site, and the producer carries $10,000 a year of extra administration and monitoring. The miner bears all other operating costs and keeps mining revenue and terminal proceeds. These are scenario terms, not a vendor offer.

$40 start, gas otherwise worth $0	Producer	Third-party miner
Initial capital	$50,000	$1,200,000
Year-one operating contribution	$129,173	$196,078
Five-year NPV, full performance	$362,180	–$989,509

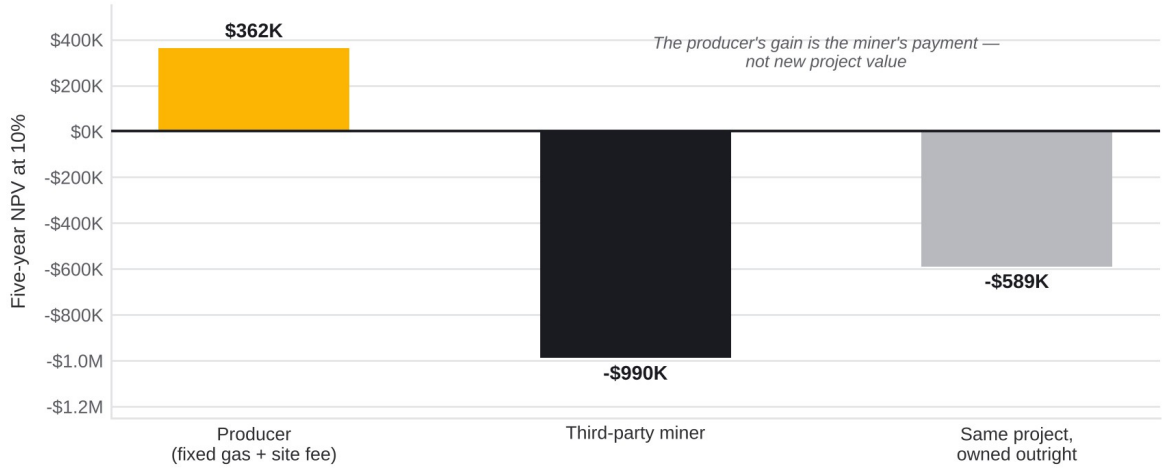

FIGURE 6 The same plant, split by contract. The producer's positive NPV is the miner's payment; the two NPVs sum to the integrated result less $37,908 of discounted producer administration.

The producer's apparent value is not a bankable conclusion. The miner needs a starting hashprice of $64.73 to reach zero NPV, and even the $60 scenario leaves it at –$189,326, although the integrated project is positive in that case. A profitable project can be divided into a commercially unworkable contract. Gas and site payments are transfers between the parties, not new wealth; the model checks that the two sides reconcile to the integrated case exactly.

7.3 Contract terms that deserve scrutiny

- **Payment floor.** Is it a price, a volume, a monthly minimum, or only accepted on-specification gas? A price floor alone cannot protect volume.

- **Default protection.** Collateral, guarantees, cure periods, removal security and treatment of unpaid operating obligations.
- **Dispatch and curtailment.** Who may stop mining, what happens to unused gas, and whether any payment continues during shutdown.
- **Cost allocation.** For profit sharing, the permitted deductions, affiliate charges, reserves and audit rights.
- **Measurement.** Reconcile gas energy, generator output, mining load, accepted hashrate, pool settlement and dollar receipts.
- **Exit and portability.** Relocation, restoration, equipment liens, early termination and remaining gas obligations.

8 FIELD CONDITIONS AND OPERATING ORGANIZATION

8.1 Measurements that decide whether a site qualifies

The first field campaign should measure usable gas volume over time, pressure, temperature, energy content, water and liquids, contaminants and variability across ordinary days, downtime, pumping changes and treatment disruptions. A single favorable gas test is not enough to size a plant. The generator must be matched to fuel quality and expected load, not to peak flow. Where substantial, regular load reductions are expected, several smaller engines may beat one large unit because spark-ignition efficiency falls at part load.[12]

Mining operations must stay separate from safe well production. A lost communications link, a generator trip or a miner fault must never defeat production safeguards or leave gas in an unmanaged condition. Shutdown logic, hazardous-area classification, electrical protection and emergency procedures need engineering review before commissioning; this paper does not provide a site design.

8.2 Who does what

Function	Responsibility
Production / reservoir engineering	Gas deliverability, decline, workover interaction, production counterfactual
Gas / process engineering	Fuel analysis, conditioning, pressure control, safe integration
Electrical and generation engineering	Sizing, load management, protection, commissioning
Engine service provider	Routine service, consumables, overhaul planning, outage response
Mining operations	Fleet configuration, accepted hashrate, cooling, repairs, pool settlement, security

[12] U.S. Environmental Protection Agency, *Catalog of CHP Technologies, Section 2.*

Function	Responsibility
Field operations	Inspections, access, coordination with pumpers, incident response
Commercial / finance	Netback comparison, both-party economics, invoices, working capital
Land / legal / environmental	Surface rights, lease and royalty terms, permitting, liabilities
Independent verification	Calibration checks and gas-to-cash reconciliation

Small projects may combine roles or use contractors, but the costs still exist.

9 KANSAS, OKLAHOMA AND TEXAS

Sites should be ranked by measurable economics, not by an assumption that one state is inherently better. Candidate quality depends on usable gas, its alternative value, remaining production life, access, service coverage, contractual rights and capital required. A profitable installation on a multiwell cluster says nothing about whether a single low-rate well can carry the same plant.

State	Public-data starting point	Critical limitation
Kansas	KGS lease production search by location, operator, field and API number	Lease records screen candidates; they do not measure usable gas today
Texas	RRC Production Data Query; production reported by lease, not by well	Lease-to-pad allocations must be verified before matched comparisons
Oklahoma	OCC well, completion and injection files; OTC holds official production	Well and injection files are not producing-gas volumes

Sources: Kansas Geological Survey; Railroad Commission of Texas; Oklahoma Corporation Commission.[13]

Strong early candidates have measured, stable usable gas, a low credible alternative netback, infrastructure that can be reused safely, and an equipment commitment shorter than a conservative estimate of gas life. Poor candidates rest on a single peak-flow test, disputed gas rights, unpriced conditioning, distant maintenance or an undemonstrated recompletion. For acquisitions, value the base well, the recompletion option and the gas-monetization option separately, and never pay for all three at their optimistic outcomes at once.

10 LEGAL, ENVIRONMENTAL AND ACCOUNTING BOUNDARIES

Mining on lease gas does not automatically hold a lease by production or exempt the gas from royalty. In Hobe Minerals v. Bonanza Creek Energy Operating Company and Civitas Resources, filed in Denver District Court in 2023, the mineral owner sought a declaration that its leases had expired and that

[13] Kansas Geological Survey, "Production from Kansas Oil and Gas Leases", University of Kansas; Railroad Commission of Texas, "Production Data Query System (PDQ) FAQs"; Oklahoma Corporation Commission, "Oil and Gas Data Files", Oil and Gas Conservation Division.

cryptocurrency mining did not extend them, and alleged that only a minimal royalty was paid on gas sold to the miner. At the time of Reed Smith's August 2023 analysis the complaint was the only pleading on file. It is an allegation, not a legal rule, and it is not Kansas, Oklahoma or Texas law; its value is as a reason to obtain lease-specific counsel before claiming that mining preserves lease rights.[14]

Environmental benefit needs a defined counterfactual too. Johnson, Tyner and Conrad's on-site investigation of aerially measured sources at 508 British Columbia oil and gas sites identifies combustion slip in compressor engine exhaust and unlit or blown-out flares among the largest methane contributors. That is why both the baseline flare and the new generator must be measured rather than assumed to destroy all methane. The study concerns compressor engines, not a measured fleet of mining generators, and its factors are not transferred here.[15]

The Cambridge report likewise finds that greenhouse-gas estimates for mining depend heavily on method, with its survey-based estimate well below an alternative model-based estimate. No emissions-credit revenue is included in this paper's model.[16]

Accounting should track gas production and disposition, electricity, mining activity, Bitcoin earned, sold and held, fees, equipment spending and restoration obligations separately. Gross mining receipts must not be added to unchanged gas-sales revenue when the same gas is diverted, and a producer's gas invoice and a miner's mining revenue must not both count as external revenue in a consolidated view. A longer operating life changes the timing of plugging and restoration, not the obligation.

11 HOW TO PROVE OR DISPROVE PAD-LEVEL RISK REDUCTION

11.1 A paired counterfactual design

The primary comparison should reconstruct the same pad two ways — with and without mining — on the same production and market observations. That avoids crediting mining for a better reservoir, a better crew or a younger well. A secondary comparison can use matched non-mining pads, matched on pre-installation rates, decline, gas-oil ratio, water, age, basin, service access, downtime, net revenue interest and operating cost, with pre-installation trends tested and uncertainty reported. The dataset must include abandoned pilots, contract failures, unplanned shutdowns and sites rejected after diligence; leaving them out biases the result toward attractive returns.

[14] Reed Smith LLP, "Gas-to-crypto projects: Colorado case may shed light on lease terms", M. M. Balaster and N. S. Caplan, client alert, 10 August 2023.
[15] Johnson, M. R., D. R. Tyner, and B. M. Conrad, "Origins of Oil and Gas Sector Methane Emissions: On-Site Investigations of Aerial Measured Sources", Environmental Science & Technology 57(6): 2484–2494, 2023.
[16] Cambridge Centre for Alternative Finance, *Cambridge Digital Mining Industry Report.*

11.2 Required data

Category	Minimum fields
Baseline pad	Production, realized prices, royalties and taxes, workovers, power, water, downtime, abandonment
Gas	Metered volume, HHV, pressure, composition, existing uses, alternative netback, daily availability
Generation	Fuel in, gross and net kWh, hours, load, maintenance invoices, failures, repair time
Mining	Fleet and efficiency, accepted hashrate, pool statements, rewards, fees, uptime, replacement
Contract	Prices, floors, volumes, payments, disputes, collateral, termination and default events
Liquidity	Cash, debt terms, covenants, working capital, insurance recoveries, emergency funding
Counterfactual	Documented best gas use without mining; production changes attributable to mining

11.3 Stress testing

- **Model receipts correctly.** Use historical hashprice or reconstructed reward economics, not Bitcoin price returns.
- **Preserve joint shocks.** Resample market and operating variables together, keeping serial dependence and shared outages.
- **Test adverse dependence.** Include simultaneous oil weakness and mining-margin compression, plus shut-ins that remove gas.
- **Model physical decline.** Less gas, worse part-load heat rate, failed conditioning, unavailable parts, relocation costs.
- **Test commercial failure.** Counterparty non-payment, terminated floors, delayed removal, unavailable guarantees.
- **Report uncertainty.** Intervals, sample sizes, matching sensitivity and the effect of excluding exceptional periods.

11.4 Decision gates, set before the pilot

1. **Technical.** Measured usable gas sustains the plant under conservative conditions without degrading safe production.
2. **Economic.** Incremental NPV is positive against the best feasible alternative after full costs, return, taxes and commercial burdens.
3. **Liquidity.** Funding needs and severe downside stay within an approved reserve under joint adverse shocks.

4. **Contract.** Producer and partner economics are viable at the same time, and protections survive realistic default.
5. **Risk claim.** If the claim is lower dollar volatility, that metric must improve; if it is fewer shortfalls, test that instead.
6. **Evidence.** Results reconcile to meters, invoices, pool statements and cash receipts, with failed periods retained.

A pilot fails the commercial thesis if it earns mining revenue but cannot recover full incremental costs and capital, or if apparent downside protection disappears once realistic partner default is included. Failing a risk-reduction claim does not mean mining has no profitable use; it means a narrower claim replaces the stronger one.

12 LIMITATIONS

- **Illustrative inputs.** Every financial and operating input is an assumption for sensitivity testing, not a quote, a forecast or an observed return.
- **No site records.** No operator pad records or historical hashprice series were incorporated, so no causal reduction in pad risk is claimed.
- **Optimistic engineering.** Constant heat rate under declining gas and ideal modular dispatch flatter the results; part-load losses would worsen them.
- **Simplified commercial terms.** The model is unlevered, pre-tax and carries no royalty burden on mining fuel.
- **Benchmark check not re-run.** The correlation table reports the underlying analysis; the benchmark series were not re-downloaded for this edition and are price proxies only.
- **Evidence gaps.** No reviewed source provides an audited, market-wide return series for gas-to-mining sites.

13 WHAT HEARTLAND TECH AI WILL BUILD

Heartland Tech AI can make this decision more defensible by connecting production forecasts, measured gas availability, competing uses, equipment requirements and actual cash receipts in one place. The product is a gas-utilization decision module, not an automatic mining recommendation, and it returns “insufficient evidence” when critical inputs are missing.

- **Eligibility screen.** Flags inadequate gas, excessive variability, unavailable rights, missing fuel analysis, or gas life shorter than the equipment commitment.

- **Alternative-use comparison.** Ranks pipeline sale, field-power displacement, mining and no-investment cases on consistent economics.
- **Dual-party underwriting.** Shows producer, partner and consolidated cash flows without counting internal transfers as new value.
- **Gas-to-cash verification.** Reconciles fuel energy to generated electricity, accepted hashrate, pool settlement and dollars received.
- **Adaptive operations.** Compares measured results with the underwriting case and triggers review of service, downsizing, shutdown or relocation.
- **Evidence-qualified Sounder integration.** Uses only validated Sounder outputs that change production, decline, integrity or intervention decisions, kept separate from metered fuel and realized income.

The research sequence that follows asks which marginal wells and clusters hold the best gas-utilization option, then compares mining with field electrification under the same capital constraint, then addresses bankable contracts and credit protection, and finally publishes measured pilot results against the gates set out above.

CONCLUSION

The defensible proposition is narrower and stronger than "Bitcoin mining lowers oil-pad risk." Turning low-opportunity-cost gas into mining receipts can raise asset value under the right physical and financial conditions, and well-built contracts can move some mining exposure away from the producer. Neither low price correlation nor an extra revenue line proves reduced total risk. The published research supports the technical pathway and the importance of mining-market, equipment and operating assumptions, but not a general claim of pad-level risk reduction. The model shows why first-year operating profit, lifetime investment value and contractual risk transfer can point in different directions. Stranded gas should be underwritten as a conditional option, with both parties' economics and measured downside outcomes on the table — not sold as an automatic hedge.

This is research and analysis only, not personalized financial, legal or investment advice. Consult qualified advisors before making investment decisions.

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This paper was prepared by Michael Schuler of Heartland Tech AI. The analysis, scenario construction, and any errors are the author's own.

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