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UDC: 622.279:621.31:004.738.5 (575.1) LOW-DEBIT HYDROCARBON FIELDS AS A LOCAL POWER SOURCE FOR BITCOIN MINING IN KARAKALPAKSTAN

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Abstract. This article develops a Field-to-Hash screening method for evaluating the conversion of gas from low-debit, depleting, and transport-isolated hydrocarbon fields into electricity for Bitcoin mining. The proposed method integrates sustainable gas flow, generator efficiency, Power Usage Effectiveness (PUE), ASIC efficiency, and annual operational availability. A 10 MW power plant requires approximately 54.5–65.8 thousand m³ of natural gas per day and can support approximately 606 PH/s of computing capacity before accounting for downtime. The proposed methodology provides a practical preliminary appraisal tool for the development of Besqala Mining Valley projects.

Keywords: low-debit hydrocarbon field; stranded gas; distributed power generation; Bitcoin mining; gas engine; operational availability; Karakalpakstan; Besqala Mining Valley.

Аннотация. В статье разработан скрининговый метод «Field-to-Hash» для оценки возможности преобразования газа низкодебитных, истощающихся и транспортно изолированных углеводородных месторождений в электроэнергию для майнинга Bitcoin. Предлагаемая методика объединяет устойчивый дебит газа, коэффициент полезного действия генератора, показатель PUE (Power Usage Effectiveness), эффективность ASIC-оборудования и годовую эксплуатационную доступность. Для электростанции мощностью 10 МВт требуется 54,5–65,8 тыс. м³ природного газа в сутки, что позволяет обеспечить около 606 PH/s вычислительной мощности до учёта плановых простоев. Предложенный подход представляет собой практический инструмент для предварительной технико-экономической оценки проектов Besqala Mining Valley.

Ключевые слова: низкодебитное углеводородное месторождение; транспортно изолированный газ; распределённая генерация электроэнергии; майнинг Bitcoin; газовый двигатель; эксплуатационная доступность; Каракалпакстан; Besqala Mining Valley.

INTRODUCTION

Uzbekistan is currently facing two parallel developments that create both challenges and new opportunities. On the one hand, domestic natural gas production has declined significantly, decreasing from 65.96 to 41.52 billion m³ between 2010 and 2024, while domestic consumption reached 47.06 billion m³ in 2024 [16]. On the other hand, the Besqala Mining Valley special mining zone has been established in the Republic of Karakalpakstan. Its regulatory framework allows residents to generate electricity through the development, maintenance, and operation of low-debit, depleting, economically marginal, and transport-isolated hydrocarbon fields, and to utilize this electricity for cryptocurrency mining [15; 14]. Although the regulatory framework provides this opportunity, assessing the technical and economic feasibility of such projects requires additional engineering and economic analysis beyond the existing regulations.

The research gap addressed in this paper is primarily practical. Although the regulatory framework identifies the categories of hydrocarbon fields eligible for such projects, it does not provide a standardized methodology for determining whether a specific field can sustainably support cryptocurrency mining operations. At the same time, the existing international literature on flare-gas utilization and behind-the-meter Bitcoin mining [8–9] is largely based on North American production conditions, infrastructure, and market characteristics, which cannot be directly applied to the geological, technical, and economic conditions of Karakalpakstan. Consequently,

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there is currently no practical screening methodology that effectively bridges regulatory provisions and field-level project evaluation.

This study does not seek to evaluate the overall profitability of the Besqala Mining Valley initiative. Instead, it focuses on developing a transparent technical and economic assessment framework that traces the complete energy conversion chain—from gas production and gas treatment to electricity generation, mining equipment operation, and computational capacity. The primary contribution of this research is the development of a simple, transparent, and reproducible Field-to-Hash screening methodology that converts sustainable gas production rates into potential Bitcoin mining hashrate while accounting for auxiliary electricity consumption and operational availability. This methodology is intended as a first-stage assessment tool that can support future comparative analyses involving grid electricity, renewable energy sources, energy storage systems, and field-based gas-powered generation.

One characteristic of Bitcoin mining makes this concept particularly suitable for remote energy resources. Unlike most industrial products, Bitcoin mining does not require physical transportation of the final product. Electrical energy is converted directly into computational work, while the resulting digital output is transmitted via an Internet connection. Consequently, mining equipment can be deployed directly at remote energy sources instead of transporting either natural gas or electricity over long distances. Furthermore, containerized ASIC mining units can be installed incrementally, allowing mining capacity to be matched with the sustainable production capacity of individual hydrocarbon fields [9; 12].

Another important operational characteristic of Bitcoin mining is its ability to tolerate temporary interruptions in power supply. When electricity becomes unavailable, ASIC miners simply suspend computational operations. Once power and network connectivity are restored, mining resumes automatically without losing previously accepted computational shares. Although temporary outages do not damage mining equipment or invalidate completed computational work, they reduce productive operating time and leave capital-intensive equipment temporarily idle. Therefore, evaluating project feasibility requires consideration not only of electricity generation costs but also of the actual annual availability of electrical power. Accordingly, Section 2 reviews the relevant literature and identifies the existing research gap; Section 3 presents the methodological framework, screening procedure, and model parameters; Section 4 reports the calculated gas flow and hashrate requirements; and Section 5 discusses the implications of the findings for the utilization of marginal gas resources and the future development of the Besqala Mining Valley initiative.

LITERATURE REVIEW

Early studies on Bitcoin's electricity consumption primarily focused on estimating the energy demand of a network for which direct consumption data were unavailable. De Vries [3] highlighted both the scale of electricity consumption and the uncertainty associated with its measurement, while Stoll, Klaaßen, and Gallersdörfer [11] combined hardware characteristics with the geographical distribution of mining pools to estimate carbon emissions. For the purposes of the present study, the key implication is that the environmental impact of Bitcoin mining depends not only on the amount of electricity consumed but also on the carbon intensity of the energy source supplying that electricity. Consequently, network-level estimates cannot substitute for site-specific technical and economic assessments.

Subsequent research has increasingly examined Bitcoin mining as a flexible electricity load. Menati, Lee, and Xie [6] modeled Bitcoin mining within a synthetic Texas power grid and demonstrated that mining operations can respond dynamically to electricity prices and be curtailed rapidly when necessary, although the overall system impacts vary according to geographical location. Similarly, Song and Aste [10] showed that the electricity price miners can economically sustain depends on both mining revenues and equipment efficiency. In addition, industry surveys conducted by the Cambridge Centre for Alternative Finance [1] documented the global distribution of hashrate and the technical characteristics of mining equipment currently in operation. Collectively, these studies demonstrate the operational flexibility of Bitcoin mining; however, they do not provide a concise field-level methodology for determining whether a specific natural gas resource is sufficiently large and reliable to support mining operations.

Snytnikov and Potemkin [9] proposed an integrated system in which flare gas is processed on-site, utilized for electricity generation, and combined with carbon dioxide capture technologies. Their study estimated the electricity generation potential of flared gas volumes within a major hydrocarbon-producing country. Vazquez and Crumbley [12] approached the same concept from a risk management perspective, arguing that on-site Bitcoin mining provides producers with an economically valuable alternative for natural gas that might otherwise depend entirely on pipeline access. Roeck and Drennen [8] evaluated behind-the-meter Bitcoin mining at a power generation facility using a life-cycle assessment and demonstrated that environmental outcomes are highly sensitive to the counterfactual assumptions applied in the analysis. Similarly, the World Bank's research

on routine gas flaring [13] emphasizes that accurate measurement, infrastructure availability, and regulatory frameworks represent the principal constraints affecting the effectiveness of gas utilization initiatives.

When this body of literature is applied to the conditions of Karakalpakstan, two important limitations become evident. First, many previous studies rely on North American or Russian production volumes, pricing structures, infrastructure, and regulatory conditions that cannot be directly transferred to the local context. Second, these studies primarily focus on associated gas or flare-gas streams with limited immediate market access. Although such gas may have alternative economic value through collection, compression, reinjection, or local utilization, its opportunity cost should be explicitly evaluated rather than assumed to be negligible. Moreover, relatively limited attention has been devoted to low-debit and depleting hydrocarbon fields, where gas preparation costs remain significant and production volumes may gradually decline throughout the project lifecycle.

Morenov, Leusheva, Buslaev, and Gudmestad [7] investigated the integrated utilization of associated gas under remote field conditions and demonstrated that, within the configuration examined, on-site electricity generation can improve resource utilization while reducing dependence on external energy supplies. In addition, technical documentation published by equipment manufacturers [2; 5] provides the electrical efficiency benchmarks required for preliminary system sizing. Most engineering studies, however, determine electricity generation capacity based on a predefined process load. Bitcoin mining introduces the opposite approach, whereby modular mining capacity can be adjusted according to the sustainable gas production rate. Under these conditions, reservoir decline becomes a critical design constraint because mining equipment installed based on initial production rates may become progressively underutilized as field output decreases over time.

The closest regional experience is that of Kazakhstan. Estecahandy [4] documented the rapid relocation of Bitcoin mining capacity following China's regulatory restrictions introduced in 2021, the resulting pressure on an already constrained electricity system, and the subsequent regulatory measures adopted in response. This regional experience demonstrates that Bitcoin mining supplied from a shared electricity grid may intensify resource allocation challenges when electricity availability is limited. Although Uzbekistan operates under a different institutional framework, domestic natural gas production declined more rapidly than consumption during the period 2010–2024, and national consumption exceeded domestic production in 2024 [16]. By allowing eligible investors to utilize hydrocarbon resources that are otherwise difficult to commercialize, the Besqala Mining Valley framework [15; 14] has the potential to reduce direct dependence on the national electricity grid. To the best of the author's knowledge, this specific energy utilization mechanism has not yet been systematically evaluated in the existing academic literature.

Based on the reviewed literature, three principal research gaps can be identified. First, no previous study has proposed a concise and reproducible methodology that converts sustainable field gas production into the Bitcoin mining capacity it can support under the regulatory categories defined within the Besqala Mining Valley framework. Second, the opportunity cost of natural gas is frequently treated only implicitly, despite its strategic importance in a country experiencing a domestic gas supply deficit. Third, annual operational availability is commonly assumed rather than explicitly incorporated into analytical models, even though well interventions, generator maintenance, and declining reservoir pressure may substantially reduce annual electricity generation. The Field-to-Hash screening methodology proposed in this study addresses these limitations by integrating sustainable gas flow, generator efficiency, Power Usage Effectiveness (PUE), ASIC efficiency, and annual operational availability into a single transparent and reproducible analytical framework.

RESEARCH METHODOLOGY

Five closely related resource categories frequently referenced in regulations and the technical literature are often used interchangeably, although each has distinct implications for project design and evaluation.

The term "low-debit" refers to a low production flow rate rather than to gas with no economic value. A low-debit well may produce insufficient gas to justify the construction of a new pipeline while still requiring workovers, gas separation, dehydration, compression, metering, and routine maintenance. A depleting field is characterized by declining reservoir pressure and decreasing production over time; therefore, electricity generation capacity should be designed based on sustainable long-term production rather than short-term well-test results. Stranded or transport-isolated gas refers to gas that has no economically viable route to market. Associated gas is produced together with crude oil and may be collected, reinjected, utilized on-site, or flared. Flare gas is the portion of associated gas that is intentionally routed to a flare system and combusted. These five categories differ significantly in terms of production stability, gas treatment requirements, and alternative utilization options. Accordingly, this study considers them separately throughout the analysis [8–9].

The most suitable conditions for on-site electricity generation generally occur where a stable gas stream cannot be economically delivered to the national energy system and would otherwise be routinely flared or remain unutilized. Even under such circumstances, any environmental benefits should be evaluated against

a clearly defined baseline scenario rather than assumed automatically. Utilizing natural gas for Bitcoin mining should not inherently be regarded as environmentally sustainable, since gas combustion continues to generate carbon dioxide emissions, while poorly operating gas engines may also increase methane emissions. Consequently, accurate metering of both gas consumption and electricity generation is treated in this study as a fundamental requirement rather than an optional component, consistent with the World Bank's approach to routine gas flaring, which emphasizes the importance of measurement, infrastructure, and regulatory oversight [13].

The proposed methodology consists of four sequential steps. The first step converts a sustainable daily natural gas flow into continuous electrical power output:

Pe=Qg×HLHV×ηe24,000(1)

where Pedenotes continuous electrical output (MW), Qg is the natural gas flow rate (m³/day), HLHV represents the lower heating value (kWh/m³), and ηe is the electrical efficiency of the gas generator.

The second step accounts for the electricity consumed by auxiliary systems within the facility. Cooling equipment, ventilation systems, pumps, transformers, and control systems all consume a portion of the gross electrical output. This proportion is conventionally expressed using Power Usage Effectiveness (PUE):

PIT=PePUE(2)

At a PUE of 1.10, approximately 90.9% of the gross electricity generated is available for ASIC mining equipment.

The third step converts the available IT electrical load into computational capacity:

HR=PIT×106ηASIC×103(3)

where HR represents hashrate (PH/s) and ηASIC denotes ASIC energy efficiency (J/TH). Under an efficiency level of 15 J/TH, approximately 66.7 PH/s of computational capacity can be achieved per megawatt of IT load.

The fourth step distinguishes installed (nameplate) capacity from the average computational output achieved over an entire year. Let A denote the annual availability factor, defined as the ratio of actual operating hours to the 8,760 hours in one calendar year. The effective average hashrate is therefore calculated as:

HReff=HR×A,A=hop8,760(4)

The calculations employ a deliberately transparent baseline lower heating value of 10 kWh/m³, together with three generator electrical efficiency scenarios—36.5%, 41.5%, and 44.0%—derived from gas generator manufacturer specifications [2; 5]. The analysis assumes a PUE of 1.10 and an ASIC efficiency of 15 J/TH. Three operational availability scenarios (95%, 85%, and 70%) are evaluated to represent conditions ranging from highly reliable operation to installations experiencing frequent well or generator downtime.

None of these parameter values should be interpreted as forecasts for any specific project. In practical applications, they should be replaced by laboratory analyses of gas composition, measured generator performance, and documented operational availability for the specific field under consideration. National natural gas production and consumption data for the period 2010–2024 were obtained from the SDMX datasets of the National Statistics Committee [16], while the regulatory parameters governing the special mining zone were derived from the founding documents of Besqala Mining Valley [15; 14].

For the economic component of the screening methodology, the cost of field-based electricity generation is defined comprehensively to include the economic value of the natural gas itself, well rehabilitation, gas gathering and treatment, compression, generator capital investment, overhaul reserves, lubricants, operating personnel, cooling systems, telecommunications, production downtime, environmental monitoring, and eventual site decommissioning. A mining project satisfies the screening criterion only when this total cost remains below the maximum electricity price that can be economically supported under prevailing hashprice, network difficulty, and mining equipment performance conditions [10; 1].

The purpose of adopting such a comprehensive cost boundary is to avoid one of the most common simplifications encountered in similar assessments—namely, assuming that remote or stranded natural gas has no economic value simply because it is not currently being marketed or utilized. This study explicitly recognizes that such gas represents a valuable resource whose opportunity cost should be incorporated into any realistic technical and economic evaluation.

ANALYSIS AND RESULTS

Table 1 applies Equations (1)–(3) to three different plant capacities, providing an initial assessment of the scale of gas production that a hydrocarbon field must sustainably support for Bitcoin mining operations (Table 1).

Table 1. Screening relationship between gas flow and mining capacity

Gross output	Gas required, m³/day (36.5–44.0%)	IT load at PUE 1.10	Potential hashrate at 15 J/TH
1 MW	5,455–6,575	0.909 MW	60.6 PH/s
5 MW	27,273–32,877	4.545 MW	303.0 PH/s
10 MW	54,545–65,753	9.091 MW	606.1 PH/s

Source: author's calculations using equations (1)–(3) and the parameters of Section 3.3.

The results demonstrate that the term "low-debit" alone provides very limited information about the actual scale of a potential project. A 10 MW power generation facility requires a stable natural gas supply of approximately 55–66 thousand m³ per day, excluding gas preparation and processing losses. Consequently, a field producing less than 5–7 thousand m³/day is generally insufficient to sustain even 1 MW of continuous electricity generation, although a smaller modular installation may remain technically feasible. Multiple wells can, of course, be integrated to increase the available gas supply; however, additional gathering pipelines, compression facilities, and maintenance requirements increase overall project costs.

Installed generation capacity and actual annual electricity production represent two different performance indicators, and Equation (4) illustrates the extent to which they may differ under varying operational conditions. Table 2 applies this relationship to the 10 MW reference case, demonstrating the effect of annual operational availability on effective electricity generation and Bitcoin mining capacity (Table 2).

Table 2. Effective hashrate of a 10 MW installation at different availability levels

Availability, A	Operating hours per year	Hours lost vs. 100%	Effective hashrate, PH/s
100%	8,760	0	606.1
95%	8,322	438	575.8
85%	7,446	1,314	515.2
70%	6,132	2,628	424.3

Source: author's calculations using equation (4).

A reduction in annual operational availability from 95% to 70% eliminates approximately 2,190 operating hours per year and decreases the effective hashrate from 575.8 PH/s to 424.3 PH/s, representing a reduction of approximately 26%, even though the physical capacities of both the generator and the ASIC mining fleet remain unchanged. Consequently, during the preliminary screening stage, an unsupported assumption regarding operational availability may have a greater impact on the results than moderate uncertainty in the assumed heating value of the natural gas.

Field depletion produces a similar effect through a different mechanism. As natural gas production gradually declines, portions of the installed generating capacity and mining equipment may operate below their designed capacity, reducing the utilization of previously invested capital. For this reason, a practical project configuration should employ multiple smaller gas generator units together with modular mining containers rather than a single oversized installation. Such a modular approach allows generation and mining capacity to be expanded or reduced in accordance with sustainable gas production over the life of the field.

A technically and economically reliable project evaluation requires detailed operational information, including monthly gas production history, reservoir pressure, gas composition, expected production decline, planned well intervention schedules, and generator maintenance programs. Battery energy storage systems may help mitigate short-term power interruptions; however, their economic feasibility, as well as comparative assessments involving solar and wind energy systems, falls beyond the scope of the present study and represents an important direction for future research.

The screening results should also be interpreted within the broader context of Uzbekistan's natural gas sector. According to official statistics, domestic natural gas production declined by approximately 37% between 2010 and 2024, while national consumption exceeded domestic production by approximately 5.5 billion m³ in 2024 [16]. Figure 1 illustrates these production and consumption trends over the study period (Figure 1).

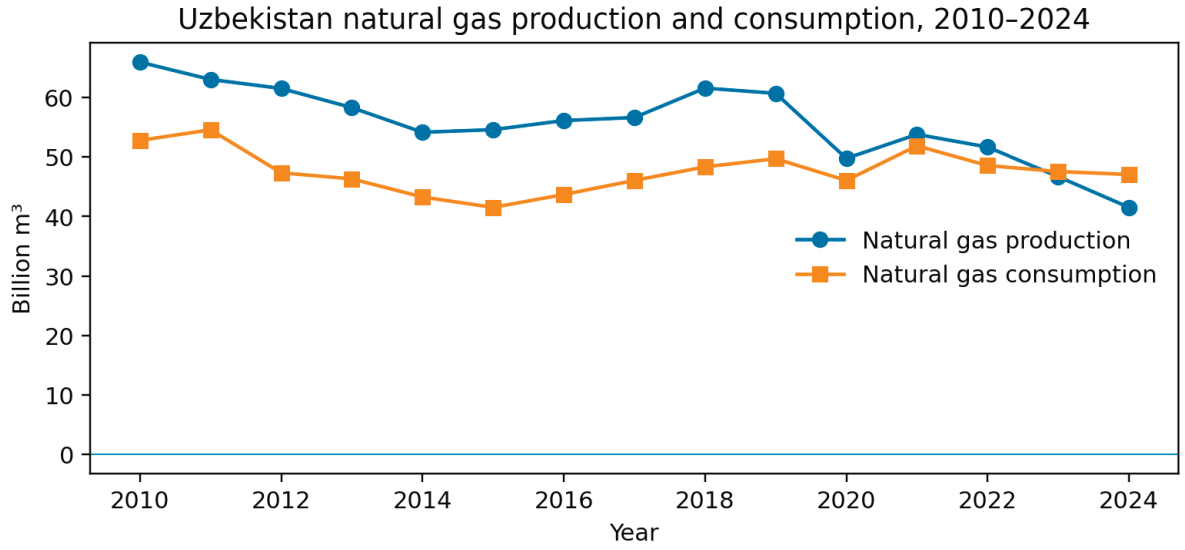

Figure 1. Natural-gas production and consumption in Uzbekistan, 2010–2024[1].

A deficit of this magnitude changes the economic significance of each additional cubic metre of gas. Gas that may appear technically marginal at the wellhead can still possess considerable value at the national level, and the calculations presented in Tables 1 and 2 do not determine which of the competing end uses should be prioritized.

The most critical assumption in a project of this type is the opportunity cost of gas. Figure 1 demonstrates why a zero opportunity cost should not be assumed automatically. Project appraisal should first evaluate all technically and economically feasible alternatives. Transport-isolated gas may indeed represent a special case; however, the applicant should demonstrate why on-site electricity generation is more appropriate than pipeline connection, gas compression, local industrial utilization, or preserving the resource for future use. Accordingly, the key question is not whether the gas appears inexpensive, but whether a more beneficial and feasible alternative use exists.

The environmental rationale requires the same level of analytical rigor. On-site electricity generation is frequently presented as an alternative to routine gas flaring, and where gas would otherwise be continuously flared, this argument may be well justified. However, such a comparison is valid only when the counterfactual scenario is clearly defined and gas volumes are accurately measured. Without reliable metering at both the gas inlet and the electricity output, any claim regarding emission reductions remains an assumption rather than an evidence-based result. This conclusion is consistent with the findings of the World Bank's research on routine gas flaring [13].

The regulatory framework establishes a legal connection between cryptocurrency mining and projects utilizing unprofitable, low-yield, depleting, and transport-isolated hydrocarbon fields [15]. The model proposed in this study complements this framework by translating that general concept into a concise set of measurable technical questions:

What is the sustainable gas flow rate?

How rapidly is production expected to decline?

What level of gas treatment is required?

What is the actual generator efficiency under operating conditions, rather than the manufacturer's rated value?

How much electricity ultimately reaches the ASIC equipment?

How many hours per year will the system operate?

What is the opportunity cost of the gas resource?

The Directorate of Besqala Mining Valley, together with other authorized institutions, could apply these seven indicators as an initial screening checklist when evaluating resident applications. Although this checklist does not replace detailed geological, environmental, or investment assessments, it provides a practical preliminary evaluation tool. Its principal advantage is that it helps avoid two common misconceptions: first, dismissing every low-debit field as economically insignificant; and second, assuming

1 compiled by the author from National Statistics Committee SDMX data [16].

that every marginal field automatically provides low-cost electricity. Both assumptions may arise from a literal interpretation of the regulatory framework and can lead to inefficient allocation of resources and analytical attention.

The limitations of this study should also be clearly acknowledged. The assumed heating value, generator efficiencies, PUE, and ASIC efficiency represent baseline engineering assumptions rather than site-specific measurements. In addition, no field-level production data from Karakalpakstan were incorporated into the calculations. The model is deterministic and does not account for fluctuations in Bitcoin hash price or changes in network difficulty. Furthermore, although the cost framework presented in Section 3.4 is clearly defined, it has not yet been populated with project-specific cost data. Consequently, the proposed model should be regarded as a screening tool rather than a complete investment appraisal methodology.

This also defines the direction for future research. A subsequent international study may incorporate site-specific flare locations and gas volumes, electricity tariffs, solar and wind resource assessments, battery storage and hybrid energy configurations, as well as current cryptocurrency mining market data to determine which energy solution provides the greatest economic value within the Besqala Mining Valley framework. The methodology developed in this study is intended to establish a consistent analytical basis for such comparative evaluations.

CONCLUSION AND RECOMMENDATIONS

Low-debit, depleting, transport-isolated, associated, and flare gas represent related but distinct resource categories. What they share is a potential mismatch between the location or volume of gas production and the capacity of conventional transport infrastructure to handle it economically. Bitcoin mining can technically utilize such energy because the computational load is modular, can be deployed directly at the field, and resumes operation after interruptions without losing previously accepted computational work.

Three key findings emerge from the screening calculations. First, a 10 MW installation requires approximately 54.5–65.8 thousand m³ of gas per day. Second, assuming a PUE of 1.10 and an ASIC efficiency of 15 J/TH, such a facility can support approximately 606 PH/s before accounting for downtime. Third, system availability and field decline can substantially reduce actual annual output. A decrease in availability from 95% to 70% reduces the effective annual hashrate by approximately one-quarter, even though the installed generation and mining equipment remain unchanged. Therefore, project evaluation should simultaneously consider gas flow, generator efficiency, auxiliary power consumption, ASIC efficiency, operating availability, and the opportunity cost of gas. None of these factors should be treated as implicit assumptions.

For Karakalpakstan, these findings provide a clear technical and economic starting point for evaluating the hydrocarbon-to-energy mechanism envisaged under the Besqala Mining Valley framework. The proposed methodology does not claim that field-based Bitcoin mining is universally profitable, nor is that its purpose. Instead, it establishes a transparent screening framework that identifies the key technical and economic parameters requiring assessment before investment decisions are made. In this way, the proposed Field-to-Hash methodology provides a practical foundation for subsequent comparative analyses involving alternative energy options and detailed project feasibility assessments.

REFERENCES

1. Cambridge Centre for Alternative Finance. *Cambridge Digital Mining Industry Report*. – Cambridge: Cambridge Judge Business School, 2025.
2. Caterpillar Inc. *Cat G3516A and Cat CG132B-16 Gas Generator Set Specifications*. – Irving, Texas, 2026.
3. de Vries A. Bitcoin's Growing Energy Problem // *Joule*. – 2018. – Vol. 2, No. 5. – P. 801–805. – DOI: 10.1016/j.joule.2018.04.016.
4. Estecahandy H. Geopolitics of Cryptocurrency Mining in Kazakhstan // *Central Asian Survey*. – 2024. – Vol. 43, No. 3. – P. 327–345. – DOI: 10.1080/02634937.2024.2324192.
5. INNIO Jenbacher GmbH & Co OG. *Jenbacher J420 Gas Engine: Technical Product Information*. – Jenbach, 2026.
6. Menati A., Lee K., Xie L. Modeling and Analysis of Utilizing Cryptocurrency Mining for Demand Flexibility in Electric Energy Systems: A Synthetic Texas Grid Case Study // *IEEE Transactions on Energy Markets, Policy and Regulation*. – 2023. – Vol. 1, No. 1. – P. 1–10. – DOI: 10.1109/TEMPR.2022.3230953.
7. Morenov V., Leusheva E., Buslaev G., Gudmestad O.T. System of Comprehensive Energy-Efficient Utilization of Associated Petroleum Gas with Reduced Carbon Footprint in the Field Conditions // *Energies*. – 2020. – Vol. 13, No. 18. – Article 4921. – DOI: 10.3390/en13184921.

8. Roeck M., Drennen T. Life Cycle Assessment of Behind-the-Meter Bitcoin Mining at a US Power Plant // *The International Journal of Life Cycle Assessment*. – 2022. – Vol. 27. – P. 355–365. – DOI: 10.1007/s11367-022-02025-0.
9. Snytnikov P., Potemkin D. Flare Gas Monetization and Greener Hydrogen Production via Combination with Cryptocurrency Mining and Carbon Dioxide Capture // *iScience*. – 2022. – Vol. 25. – Article 103769. – DOI: 10.1016/j.isci.2022.103769.
10. Song Y.-D., Aste T. The Cost of Bitcoin Mining Has Never Really Increased // *Frontiers in Blockchain*. – 2020. – Vol. 3. – Article 565497. – DOI: 10.3389/fbloc.2020.565497.
11. Stoll C., Klaaßen L., Gallersdörfer U. The Carbon Footprint of Bitcoin // *Joule*. – 2019. – Vol. 3, No. 7. – P. 1647–1661. – DOI: 10.1016/j.joule.2019.05.012.
12. Vazquez J., Crumbley D.L. Flared Gas Can Reduce Some Risks in Crypto Mining as Well as Oil and Gas Operations // *Risks*. – 2022. – Vol. 10, No. 6. – Article 127. – DOI: 10.3390/risks10060127.
13. World Bank. *Global Gas Flaring Tracker Report 2026*. – Washington, DC: World Bank, 2026.
14. O‘zbekiston Respublikasi Istiqbolli loyihalar milliy agentligi. *Information on Establishment of a Special Mining Zone in the Republic of Karakalpakstan*. – Tashkent, 20 April 2026.
15. O‘zbekiston Respublikasi Istiqbolli loyihalar milliy agentligi. *Regulation on Registration and Operation of Residents of the “Besqala Mining Valley” Special Mining Zone*. Order No. 22 of 22 June 2026, registered by the Ministry of Justice under No. 3893 on 8 July 2026. – Tashkent, 2026.
16. O‘zbekiston Respublikasi Milliy statistika qo‘mitasi. *Natural Gas Production and Consumption SDMX Datasets, 2010–2024*. – Tashkent, 2026.

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