Bitcoin Mining in Africa

A Strategic Outlook On Energy, Innovation, And Sustainable Development (2025-2030)

Executive Summary

Africa is rapidly emerging as a pivotal frontier in the global Bitcoin mining landscape, driven by its vast, untapped renewable energy resources and a growing imperative for economic diversification. The continent’s unique energy profile, characterized by abundant and often "stranded" hydropower, solar, wind, and geothermal potential, offers a compelling competitive advantage for energy-intensive Bitcoin mining operations. This report highlights how Bitcoin mining is not merely a commercial venture but a significant catalyst for energy infrastructure development, rural electrification, and foreign exchange generation across African economies.

While the sector faces challenges, including regulatory uncertainties, operational hurdles related to infrastructure deficits, and environmental scrutiny, a pragmatic and evolving policy landscape is fostering increased institutional investment and strategic partnerships. Looking ahead to 2030, the convergence of Bitcoin mining with artificial intelligence (AI) and high-performance computing (HPC) is poised to transform Africa into a dual-use digital infrastructure hub. Successful integration hinges on developing clear, consistent regulatory frameworks, prioritizing local community benefits, and fostering a "shared value" ecosystem that aligns commercial incentives with sustainable development goals. Africa’s trajectory in Bitcoin mining is set to redefine its role in the global digital economy, positioning it as a proactive shaper of technological and energy innovation.

2.

Africa’s Emergence as a *Bitcoin Mining Frontier*

The global Bitcoin mining industry has undergone a profound transformation, evolving into a more professional, regulated, and capital-intensive sector. This shift has raised barriers to entry, placing a premium on efficiency, legal compliance, and sustainability for operators seeking long-term viability.[1] Following the 2024 Bitcoin halving event, which significantly tightened profitability by reducing block subsidy, miners worldwide have intensified their search for regions offering cheap, reliable power. This economic pressure has catalyzed a migration of mining operations, with Africa, the Middle East, and Central Asia now recognized as key battlegrounds for energy arbitrage opportunities.[2] This global reorientation positions Africa uniquely to absorb a substantial portion of the migrating hash rate.

Africa is increasingly recognized as a strategic hub for Bitcoin mining, largely due to its immense, largely untapped renewable energy resources. The continent boasts vast potential in hydropower, solar, wind, and geothermal energy.[3] While its current contribution to the global hash rate remains relatively small, it is experiencing rapid growth, with Ethiopia leading this expansion.[7] This combination of abundant, often underutilized clean energy and a burgeoning digital economy makes Africa a compelling new frontier for the industry.

The continent's energy surplus naturally aligns with the global mining industry's demand for low-cost, sustainable power. This alignment represents a strategic relocation of a global industry to a continent uniquely positioned to supply its primary input in an environmentally conscious manner. This movement is not merely about securing inexpensive energy; it signifies a fundamental restructuring of the global mining footprint.

Furthermore, Bitcoin mining is demonstrating its potential to act as a significant catalyst for African energy infrastructure development. African utilities frequently face challenges such as charging subsidized electricity rates, incurring high-interest debt for large-scale projects, and struggling to attract industrial customers due to insufficient generation capacity.[9] Mini-grids, while vital for rural electrification, often struggle with low returns on investment without external subsidies.[11] Bitcoin mining, being adaptable in location and capable of utilizing "stranded energy"—excess power that would otherwise go unused due to transmission bottlenecks—can provide a consistent, predictable, and crucially, dollar-denominated revenue stream.[1] This stable income can substantially improve the creditworthiness of African utilities, reduce their reliance on burdensome loans, and make new energy expansion plans financially viable.[9] Consequently, Bitcoin mining is not just an energy consumer; it is proving to be an enabler, facilitating the economic viability of new energy projects and accelerating electrification across the continent.

3.

The Current Landscape of *Bitcoin Mining In Africa* (2024-2025)

The Bitcoin mining sector in Africa is characterized by rapid expansion, increasing hash rate contributions, and growing investment, particularly from international players seeking sustainable and cost-effective energy solutions.

Scale and Infrastructure

Africa's share of the global Bitcoin hash rate is experiencing substantial growth. As of December 2024, the continent accounted for 3% of the global hash rate, a notable increase from the previous year.[8] Ethiopia, in particular, has emerged as a frontrunner, contributing 2.5% of the global hash rate by October 2024, a figure that more than doubled the entire continent's output from 2023, achieved entirely through renewable energy sources.[7] Projections indicate that Ethiopia's share of the global hash rate could further increase to approximately 7% by the end of 2025.[7]

Major Operational Hubs and Capacities

Ethiopia

Ethiopia has rapidly emerged as a significant hub for Bitcoin mining, now ranking as the fourth globally as a Bitcoin mining destination in terms of hash rate, often cited after the United States, Hong Kong, and other major Asian mining hubs.[6] This ascendancy is primarily attributed to its abundant and exceptionally cheap hydroelectric power. The country currently utilizes around 5,200 MW to 6,879 MW of hydropower, with an additional 7,300 MW planned, offering electricity at a remarkably low rate of approximately $0.036 per kilowatt-hour (kWh) including value added tax.

The state-owned Ethiopian Electric Power (EEP) has been instrumental in this growth, having signed agreements with 25 licensed mining companies, with around 11 of these actively operational.[8] EEP has dedicated approximately 600 MW to support these operations[8]. A significant majority of these companies, approximately 80%, are from China, with the remainder hailing from Russia and the United States[7]. Notable players include Phoenix Group, which has increased its total operational capacity in Ethiopia to 132 MW, with an impressive 90% of its energy sourced from renewable hydropower via the Grand Ethiopian Renaissance Dam (GERD).[11]

Other key companies include BIT Mining, which acquired 51 MW data centers and 17,869 high-performance mining machines for $14.28 million, [9] Terahash (raising $5M for a 10 MW facility and planning a 60 MW expansion),[13] Hashlabs Mining, QRB Labs, and West Data Group.[14]

The monetization of stranded energy and accelerated grid development are significant outcomes of this activity. EEP reported earning $55 million from electricity sales to miners within 10 months.[1] This figure is projected to rise significantly to $123 million in 2025.[7] These funds are being directly utilized to construct transmission lines, which are crucial for delivering power from the GERD and accelerating rural electrification efforts across the country.[4] Bitcoin mining, in this context, acts as a powerful economic catalyst, transforming underutilized natural resources into tangible revenue streams that directly fund critical national infrastructure development, thereby accelerating energy access for millions of Ethiopians.

However, Ethiopia's case also highlights a critical policy dilemma concerning subsidized energy. While miners benefit from exceptionally low electricity rates, the actual cost of electricity in Ethiopia is estimated at around $0.036/kWh, implying a substantial government subsidy.[6] This raises concerns about whether the benefits disproportionately favor foreign miners at the expense of taxpayers or other critical domestic sectors like manufacturing and housing.[6] This situation underscores the need for robust regulatory oversight and pricing strategies to ensure equitable and sustainable development, balancing immediate foreign exchange gains with long-term economic stability and public welfare.

Libya

Libya emerged as the leader in Bitcoin mining within the Arab world in 2022, a notable achievement given its ongoing political and economic instability.[16] This surge is primarily driven by the nation's exceptionally low electricity costs, which stood at approximately $0.004 per kilowatt-hour (kWh) in 2021.[17]

Despite this, Libya operates in a "legal limbo" regarding cryptocurrency. There are no explicit laws prohibiting Bitcoin mining, nor a clear regulatory framework.[16] The Central Bank of Libya (CBL) issued a warning in 2018 banning cryptocurrency transactions due to security and financial risks, including concerns about money laundering and terrorism financing.[16] Despite this prohibition, cryptocurrency usage and Bitcoin mining continue to proliferate.

The perils of unregulated energy arbitrage are starkly evident in Libya. Illegal mining operations are a significant concern, with security forces conducting numerous operations. In April 2023, authorities in Benghazi confiscated over 1,000 Bitcoin mining devices.[16] with some operations reportedly consuming between 1,000 and 1,500 megawatts.[16]

Investigations in June 2023 uncovered a large-scale operation in Zliten involving 50 Chinese nationals and Libyan partners.[16] These illegal activities are severely straining Libya’s already fragile power grid.

This high consumption leads to electricity shortages, impacting the domestic supply. While cheap energy attracts miners, the absence of a clear and enforced regulatory framework can transform a potential economic opportunity into a national security and infrastructure crisis, emphasizing the critical need for comprehensive governance to prevent exploitation and illicit activities.

Democratic Republic of Congo (DRC)

In the Democratic Republic of Congo (DRC), BigBlock Datacenter has established Bitcoin mining facilities within Virunga National Park since 2020.[18]. These operations are powered by hydroelectric energy from a plant located on the Luviro River, near Ivingu.[18] The introduction of 6.5 MW of Bitcoin mining capacity significantly increased the Luviro hydro plant's utilization from 5% to 50%.[19] This increased efficiency directly contributed to a reduction in household electricity tariffs, bringing them down from $0.35/kWh to $0.15/kWh.[19]

This project exemplifies Bitcoin mining as a model for "Productive Use of Energy" (PUE) and integrated community development. The operation is designed to be "socially useful": profits generated from the park's owned Bitcoin mining containers are directed back to Virunga National Park to support its conservation efforts.[18] Beyond financial contributions, the mining farm provides[15] full-time jobs for locals who might otherwise resort to environmentally damaging activities like burning trees for coal.[18] An innovative approach involves repurposing the heat produced by mining: by using it to dry fruits and cocoa beans, an additional 50-60 part-time jobs have been created, with potential to scale to 100-300 jobs.[18]

Furthermore, BigBlock Datacenter has invested directly in community infrastructure, providing a Toyota bus for school transportation and installing electricity in school classrooms, along with financing school repainting.[18] This case study provides a powerful blueprint for how Bitcoin mining can be integrated into local economies to drive sustainable development, particularly in remote and underserved areas, by creating a circular economy around energy and its byproducts.

However, the stark reality of operating in fragile states is also evident. Despite the profound positive impacts, the operations in the DRC have faced significant hardships, including ongoing conflict, natural disasters (such as a flash flood that caused loss of life and equipment damage), and ambushes by rebel groups.[18] The loss of life and equipment underscores the severe human and financial costs of operating in such environments. While the economic incentives of cheap hydropower are strong, pervasive insecurity

and political instability in certain African regions represent significant barriers to large-scale, long-term investment, demanding comprehensive risk assessment and robust security measures.

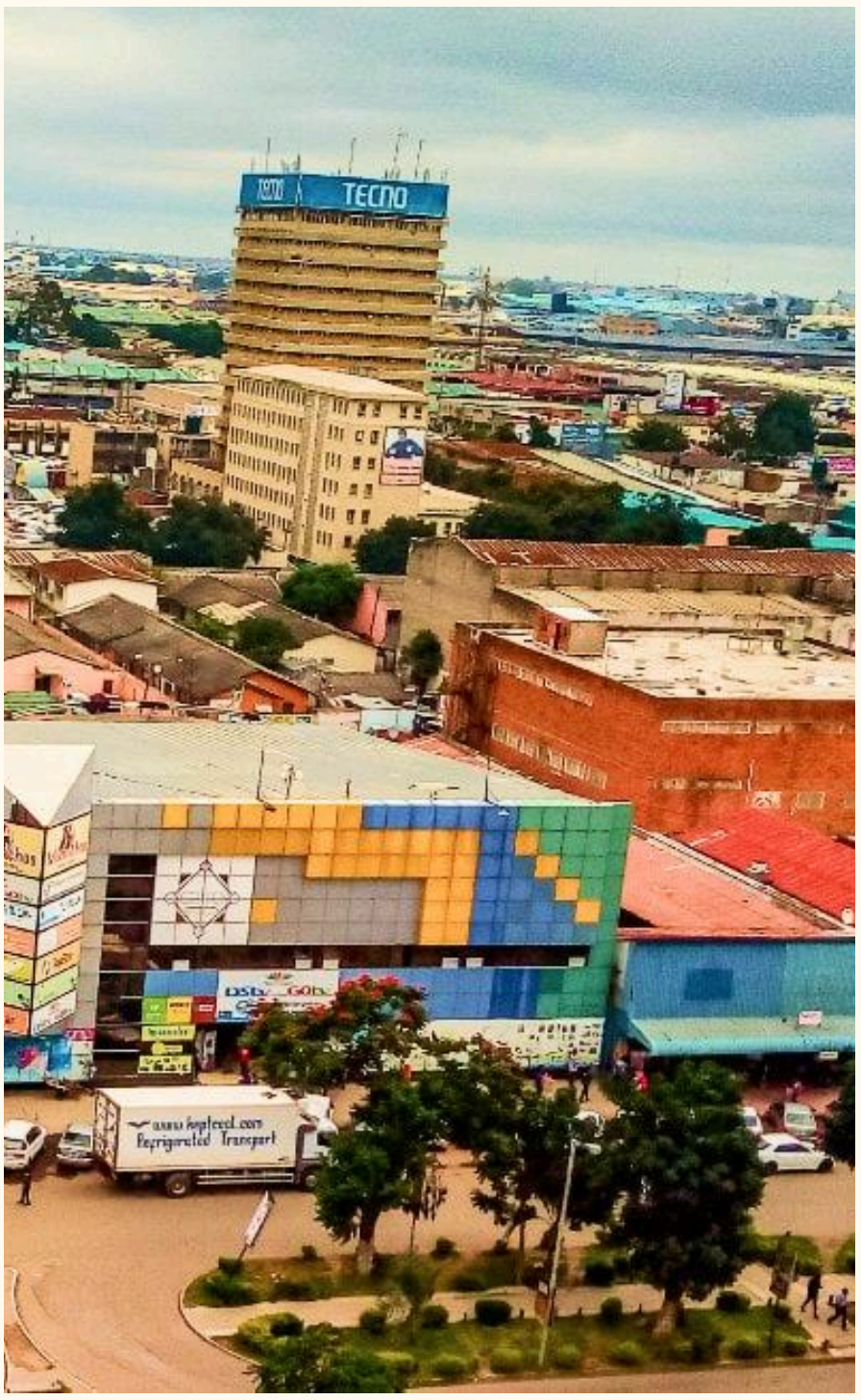
Zambia

In Zambia, Gridless, a Kenya-based company, operates a Bitcoin mine in the far northwestern tip of the country, directly connected to the Zengamina hydroelectric power plant.[21] The Zengamina plant, built in the early 2000s with charity donations to power a local hospital and community, struggled financially due to slow community take-up, resulting in the waste of over half of its generated energy daily.[21]

In Zambia, Gridless, a Kenya-based company, operates a Bitcoin mine in the far northwestern tip of the country, directly connected to the Zengamina hydroelectric power plant.[21] The Zengamina plant, built in the early 2000s with charity donations to power a local hospital and community, struggled financially due to slow community take-up, resulting in the waste of over half of its generated energy daily.[21]

The partnership with Gridless has been described as "game-changing." The Bitcoin mine now accounts for approximately 30% of the plant's revenue, which helps to keep electricity prices down for the local town.[21] Gridless utilizes a shipping container housing 120 computers, with each machine earning approximately $5 per day, subject to Bitcoin price fluctuations.[21]

This arrangement positions Bitcoin mining as a crucial "bridge" to grid viability and expansion.
By monetizing otherwise wasted energy, it provides the necessary financial stability for



the mini-grid to cover operational expenses and even fund future expansion, eventually allowing it to integrate into a larger national grid. Future plans for Zengamina include expansion to more villages and connection to the national grid, which is expected to make Bitcoin mining at this specific site no longer profitable for Gridless.[21] This model demonstrates Bitcoin mining not as a competitor for energy, but as a temporary, yet vital, partner in the early stages of electrification projects, helping to de-risk investments and accelerate the path to broader energy access and grid development.

Malawi

In Malawi, Gridless has implemented a transformative project by installing a micro-hydro mini-grid in Bondo village, nestled on the slopes of Mount Mulanje.[23] This village previously had no prospect of connection to the national grid.[23] By leveraging Bitcoin mining, Gridless generates income to sustain the mini-grid, thereby providing affordable electricity to over 1,800 homes in Bondo.[23]

This initiative highlights a model of decentralized energy access and grassroots empowerment. The electrification has profoundly impacted villagers' lives, enabling them to use lights, refrigerators, televisions, and phones in their homes. It has also fostered new economic opportunities, improved food preservation and medicine storage, and supported educational advancement for students studying at night.[23]

Remarkably, rural villages like Bondo have effectively "self-financed" their electricity access through this innovative approach.[23] This model demonstrates Bitcoin mining's potential to drive genuine grassroots development and financial inclusion in Africa's most remote areas, providing a blueprint for self-reliant, community-governed energy solutions that bypass traditional infrastructure limitations and bureaucratic hurdles. The integration of cryptocurrency also offers financial tools for the unbanked, further empowering local communities.[23]

Kenya

Kenya is emerging as a significant player in the African Bitcoin mining landscape. Gridless, a Kenya-based company, operates six similar sites across three different African countries [21], specifically deploying small-scale data centers that run on excess clean energy within Kenya.[25]

Kenyan President William Ruto has invited Marathon Digital Holdings, a prominent Bitcoin mining company, to consult with the Treasury on cryptocurrency regulations and with the Ministry of Energy regarding energy needs.[26]

Kenya possesses a surplus geothermal energy production capacity, which Bitcoin mining could effectively utilize, generating additional revenue for the country.[26] This proactive stance aims to establish a clear regulatory framework, including policies, licensing, and taxation, fostering a more structured and transparent cryptocurrency ecosystem. This approach can attract legitimate investment and enable the country to harness its unique energy advantages for economic growth while mitigating potential risks.

Block's Bitcoin Clean Energy Initiative (BCEI) invested in Gridless in 2022, signaling support for its growth and positive impact.[25] A notable development is the proactive government engagement and sector formalization.

Other local initiatives include companies like Powerhive and BitLumens which are enabling pre-paid power meters that accept mobile money and cryptocurrencies, further decentralizing energy access and empowering local communities [23].

Algeria

Algeria stands out as arguably one of the cheapest country in Africa to produce Bitcoin, with an average cost estimated at approximately $4,183 per BTC.[27] This low cost is reflected in its electricity prices: households pay an average of $0.039/kWh, while businesses pay $0.033/kWh.[27] In June 2022, Algeria reportedly accounted for a significant 10% of the global Bitcoin mining market.[27]

However, Algeria's Bitcoin mining landscape presents a fossil fuel paradox and unfulfilled renewable potential. The country is heavily dependent on fossil fuel energy and has an underdeveloped renewable energy infrastructure[27]. Despite possessing immense solar potential (capable of generating up to 2100 kilowatt-hours per year in its desert regions), current renewable energy generation remains low (e.g., only 448 MW from solar, 228 MW from hydro, and 10 MW from wind annually)[27].

The regulatory environment is also ambiguous; while some sources indicate the Algerian government has not yet established stable regulations for Bitcoin mining, others suggest it has banned Bitcoin mining due to energy concerns[27]. This conflicting information points to a dynamic and potentially inconsistent policy environment.

Algeria represents a case where the allure of cheap energy, even if fossil-fuel-derived, can drive significant mining activity. However, for sustainable growth and to align with global environmental goals, there is a critical need to transition to its abundant renewable resources and establish clear, stable regulations that address environmental impact.

Nigeria

Despite its population size and economic significance, Nigeria does not currently rank among the top 10 global Bitcoin mining countries. Yet, it holds significant potential — particularly in harnessing wasted energy. In 2021, Nigeria flared 6.63 billion cubic meters of natural gas, valued at approximately $761 million. Flaring not only wastes energy but also contributes heavily to methane emissions, which are over 80 times more harmful than CO_2 in the short term. Notably, 9% of methane escapes unburned, exacerbating its climate impact. Bitcoin mining offers a practical solution. It is one of the few commercial activities that can operate directly at remote oil sites, turning stranded or flared gas into a productive economic resource. This not only reduces emissions but also generates local value. ExxonMobil's pilot flare-gas mining project in Nigeria demonstrates the viability of this approach. Beyond gas, Nigeria has more than 14 GW of untapped hydroelectric potential. Bitcoin mining can act as an anchor customer, helping to fund and stabilize new renewable energy infrastructure. This would expand energy access for homes and businesses while reinforcing Nigeria's climate and economic goals.

- **Shuga Mines:** A Bitcoin mining firm based out of Abuja, Nigeria, operating sizable Bitcoin mining facilities. They collaborate with grid operators and integrate renewable energy sources to improve mining efficiency.

- **NRG Bloom:** Focuses on repurposing wasted energy for sustainable Bitcoin mining, aiming to provide clean power and create social impact within African communities.

- **Trojan Mining:** A key participant in Nigeria's Bitcoin mining landscape, utilizing hydroelectric and off-grid energy solutions for sustainable Bitcoin mining. Trojan Mining operates by mining off free community power near generation facilities, builds its containers and repair centers, and is deeply involved in community engagement.

The regulatory environment in Nigeria is complex. The Central Bank of Nigeria (CBN) issued a directive in February 2021 prohibiting financial institutions from facilitating cryptocurrency transactions, citing concerns over money laundering and a lack of consumer protection. Despite this, the presence of mining operations and related services indicates a dynamic, albeit challenging, environment.

Namibia

Namibia is a country with confirmed Bitcoin mining activity, primarily leveraging its abundant renewable energy resources.

Bitcoin Mining Namibia: This initiative operates in Namibia and utilizes solar and wind energy to power its Bitcoin mining activities, taking advantage of the region's abundant sunshine.

However, the regulatory landscape in Namibia presents a significant challenge. From a regulatory standpoint, cryptocurrency is considered illegal in Namibia. As of November 2018, the Bank of Namibia had not released a statement on the use or regulation of cryptocurrencies, and the government does not consider virtual currency as legal tender, prohibiting the purchase of goods and services via virtual currency. This creates a complex and uncertain environment for Bitcoin mining operations.

Emerging Markets and Untapped Potential

Beyond these established hubs, several other African nations present significant, yet largely untapped, potential for Bitcoin mining, often linked to broader energy transition and digital infrastructure development.

South Sudan

While there is no explicit Bitcoin mining occurring, South Sudan is strategically focusing on financial partnerships and geological surveys to develop its mineral sector and support the global energy transition. It’s emphasis on

energy transition and mineral potential could create future synergies with energy-intensive computing.

Morocco

Morocco stands out as an emerging market with significant, largely untapped potential for Bitcoin mining, primarily due to its abundant and rapidly expanding renewable energy resources. While historically maintaining a ban on cryptocurrencies, the nation's central bank is now actively drafting regulations, signaling a pivotal shift towards a more open, albeit controlled, environment for digital assets. This regulatory evolution, coupled with vast solar and wind energy potential, positions Morocco to become a key hub for "green Bitcoin mining." By leveraging its clean energy surplus, the country could attract significant investment in energy-intensive computing, transforming its renewable energy transition into a strategic advantage for the global Bitcoin mining industry, contingent on the final framework of its new regulations and how it navigates associated geopolitical complexities.

Nations such as **Chad**, **Guinea-Bissau, Somalia, Sierra Leone,** and the **Central African Republic** are occasionally referenced in broader discussions about energy consumption benchmarks. While some, like Ivory Coast and Liberia, have active traditional mining sectors , there is no indication of Bitcoin mining operations or specific plans for them. This suggests that while the potential for Bitcoin mining exists across the continent due to energy resources, widespread adoption is not yet universal.

The underlying infrastructure required for Bitcoin mining (reliable power, data centers) is increasingly versatile and can support other high-performance computing (HPC) applications like AI. African countries focusing on broader energy transition and digital economy strategies may thus find a natural future synergy with Bitcoin mining or other energy-intensive computing, as the foundational infrastructure can be repurposed or co-located, attracting diversified investment beyond pure cryptocurrency.

Mauritania

Mauritania is receiving support from the World Bank through the DREAM Project, aimed at boosting green hydrogen development, expanding energy storage, and promoting critical mineral potential. Although Bitcoin mining is not explicitly mentioned, the country's focus on green energy and critical minerals could align with future energy-intensive computing needs.

3.1.2 Infrastructure *Developments*

The co-location of small-scale Bitcoin data centers with renewables-based mini-grids is forming a foundational model for expanding profitable electrification in emerging markets[13] .Africa's digital economy requires substantial infrastructure, with estimates indicating a need for over 700 data centers by 2035[13]. The Africa Green Data Center Market is projected to experience significant growth, reflecting the continent's demand for sustainable digital infrastructure.

Key Players and Investment Trends

The African Bitcoin mining sector is attracting a diverse range of players and substantial investment.

International Entities: Key international players include Phoenix Group (UAE-based, recognized as a top 10 global miner) [12], Marathon Digital Holdings (a major US-based miner) [1], and other firms such as BitFuFu, Munich International Mining (MIM), and BIT Mining, which have established strategic footholds in Africa.[7]

African-Focused Operators: Notable African-focused companies include Gridless (Kenya-based) [12], Trojan Mining (Nigeria) [5], Hashlabs Mining (Ethiopia) 31, Quantum Hash (Zambia) [22], Bitcoin Mining Namibia [5], Shuga Mines (Nigeria) [5], and NRG Bloom (Nigeria).[5]

Collaborative Alliances: The Green Africa Mining Alliance, comprising companies like Trojan, Gridless Compute, Sukuma Ventures, BigBlock Datacenter, QRB, and Quantum Hash Ventures, exemplifies a commitment to using renewable energy for crypto mining across the continent[24].

Investment Flows

The sector is witnessing significant capital inflows. Ethiopia, for instance, saw over $1 billion invested in mining infrastructure in 2024[8]. Phoenix Group's initial public offering (IPO) on the Abu Dhabi Securities Exchange in late 2023 was notably oversubscribed, raising $371 million[12]. Block (Jack Dorsey's digital payments firm) and Stillmark spearheaded a $2 million seed investment into Gridless.[24] Ethiopian Investment Holdings partnered with Hong Kong-based West Data Group in a $250 million initiative aimed at developing Bitcoin mining and AI infrastructure.[29] The partnership between Marathon Digital and Kenya is expected to attract over $80 million in foreign investments[24]. This flow of Western capital into Bitcoin mining is effectively subsidizing energy infrastructure development in East Africa, as miners monetize cheap energy sources and recirculate funds back into local economies.[9]

Funding Mechanisms

Operators are increasingly focusing on negotiating long-term Power Purchase Agreements (PPAs).[1] In Ethiopia, the state-owned Ethiopian Electric Power (EEP) provides PPAs to mining companies, with the current electricity rate at USD 3.14 cents per kilowatt-hour (kWh).[34] Private equity and venture capital are also emerging as crucial funding sources, with firms like Transvaal VC specializing in junior mining and renewable energy ventures in South Africa and neighboring countries.[37]

This trend is also evident in Africa, with M&A becoming an alternative strategy for market entry or expansion in countries like Ethiopia.[34]

The rapid ascent of Ethiopia in the global Bitcoin mining landscape, contributing significantly to the global hash rate and generating substantial revenue from electricity sales, is driven by a clear government strategy. This strategy leverages the nation's abundant, cheap hydropower and mandates foreign currency payments for electricity.[12] This pragmatic approach, which permits mining while maintaining a ban on crypto transactions, creates a uniquely attractive environment for large-scale operations. This model offers a blueprint for other African nations to monetize their stranded energy assets and attract foreign investment, provided they can effectively navigate the associated regulatory complexities and public perception.

Investment in Bitcoin mining is also serving as a catalyst for broader digital infrastructure development. Bitcoin mining requires robust and scalable energy infrastructure, often leading to the development of mini-grids and data centers.[13] Africa's urgent need for hundreds of new data centers by 2035 means that the substantial investment in energy infrastructure for mining, such as the over $1 billion spent in Ethiopia in 2024 [8], creates a foundational capacity. This capacity can then support other energy-intensive digital services like AI and cloud computing.[3] This dynamic establishes a positive feedback loop where mining investment de-risks and accelerates the deployment of critical digital infrastructure, which is essential for Africa's overall digital transformation.[4]

A critical economic driver for African nations to embrace Bitcoin mining is the generation of foreign currency. Many African countries, including Ethiopia, face persistent foreign exchange shortages.[13] Bitcoin mining companies are frequently required to pay for electricity in foreign currency.[13] This provides a direct and immediate source of hard currency without the need for capital-intensive export infrastructure.[13] This economic incentive is a powerful factor for governments to permit and even encourage mining, often outweighing other regulatory or environmental concerns. It effectively transforms domestic energy resources into a tradable commodity that directly addresses a crucial national economic need.

Key Bitcoin Mining Operations in Africa (2025)

LOCATION (COUNTRY)	COMPANY/ INITIATIVE	OPERATIONAL CAPACITY ((MW/EH/s)	PRIMARY ENERGY SOURCE	KEY HIGHLIGHTS
Ethiopia	**Phoenix**	132 MW (2.4 EH/s by Q2 2025)	Hydropower (90% renewable)	Top 10 global miner,significant expansion,sustainable operations [12]
Ethiopia	**West Data Group** (Partnership with Ethiopian Investment Holdings)	**$250M** initiative (capacity not specified)	Not specified (likely hydropower)	Focus on Bitcoin mining and AI infrastructure development [29]
Zambia	**Gridless**	120 Machines (capacity not specified)	Hydro-electric (Zengamina mini-grid)	Utilizes excess energy, accounts for 30% of plant revenue, lowers local electricity prices [12]
Nigeria	**Trojan Mining**	500KW (under construction)	Hydro-powered	Aims to provide cheap power to nearby homes, part of Green Africa Mining Alliance [5]
Kenya	**Gridless Compute**	Mini-grids (under construction)	Hydro-electric	Reduces energy rates for 2,000 people, received $2M seed investment [24]
Kenya	**Marathon Digital Holdings** (Partnership with Kenya)	Not specified	Geothermal	Monetizes surplus energy, aims to attract over $80M foreign investment [24]

DRC	**Virunga National Park** (with Big Block Green Services)	6.5 MW	Hydro-electric	Net-zero mine, generates $150k/month, supports park salaries and local industries [27]
Namibia	**Bitcoin Mining Namibia**	Not specified	Solar and Wind	Leverages renewable energy in a sunny region 5

4.

Strategic Advantages *Africa's Unique Value Proposition*

Africa presents a compelling value proposition for Bitcoin mining, rooted in its abundant energy resources and the profound socio-economic benefits that can arise from strategic engagement with the industry.

Abundant and Affordable Renewable Energy

Africa possesses immense and largely untapped renewable energy resources, including vast potential for solar, hydroelectric, wind, and geothermal power.[3] Regions such as North Africa and Sub-Saharan Africa benefit from abundant solar radiation, providing an ideal environment for solar-powered data centers.[4] Kenya stands out as Africa's largest geothermal energy-producing country, with significant potential for further development.[24]

A key advantage for Bitcoin mining in Africa is the prevalence of "stranded energy"—electricity generated from renewable sources that remains unutilized due to underdeveloped transmission infrastructure or insufficient local demand.[13] Bitcoin mining is uniquely positioned to act as a "buyer of last resort" for this excess energy, providing a consistent and reliable demand that can unlock the economic viability of otherwise uneconomical renewable energy projects.[1] This capability transforms a potential liability into a valuable asset.

The economic viability of Bitcoin mining is heavily influenced by electricity costs, which can account for up to 80% of total operational expenses.[35] In this regard, Africa offers some of the most competitive rates globally. Ethiopia, for example, boasts one of the lowest Bitcoin mining costs worldwide at approximately *$1,986 per Bitcoin,* primarily due to its reliance on hydroelectric power and government-controlled energy prices.[35] This cost is remarkably low, being *54 times cheaper* than in the United States ($107,000) and *161 times cheaper* than in Ireland ($321,112), which is the world's most expensive country for Bitcoin mining.[39] Other African countries also offer highly competitive rates, with some as low as $0.03/kWh.[5] This energy profile creates a significant arbitrage opportunity for miners.

ESTIMATED ELECTRICITY COST TO MINE 1 BITCOIN IN SELECT AFRICAN COUNTRIES [78]

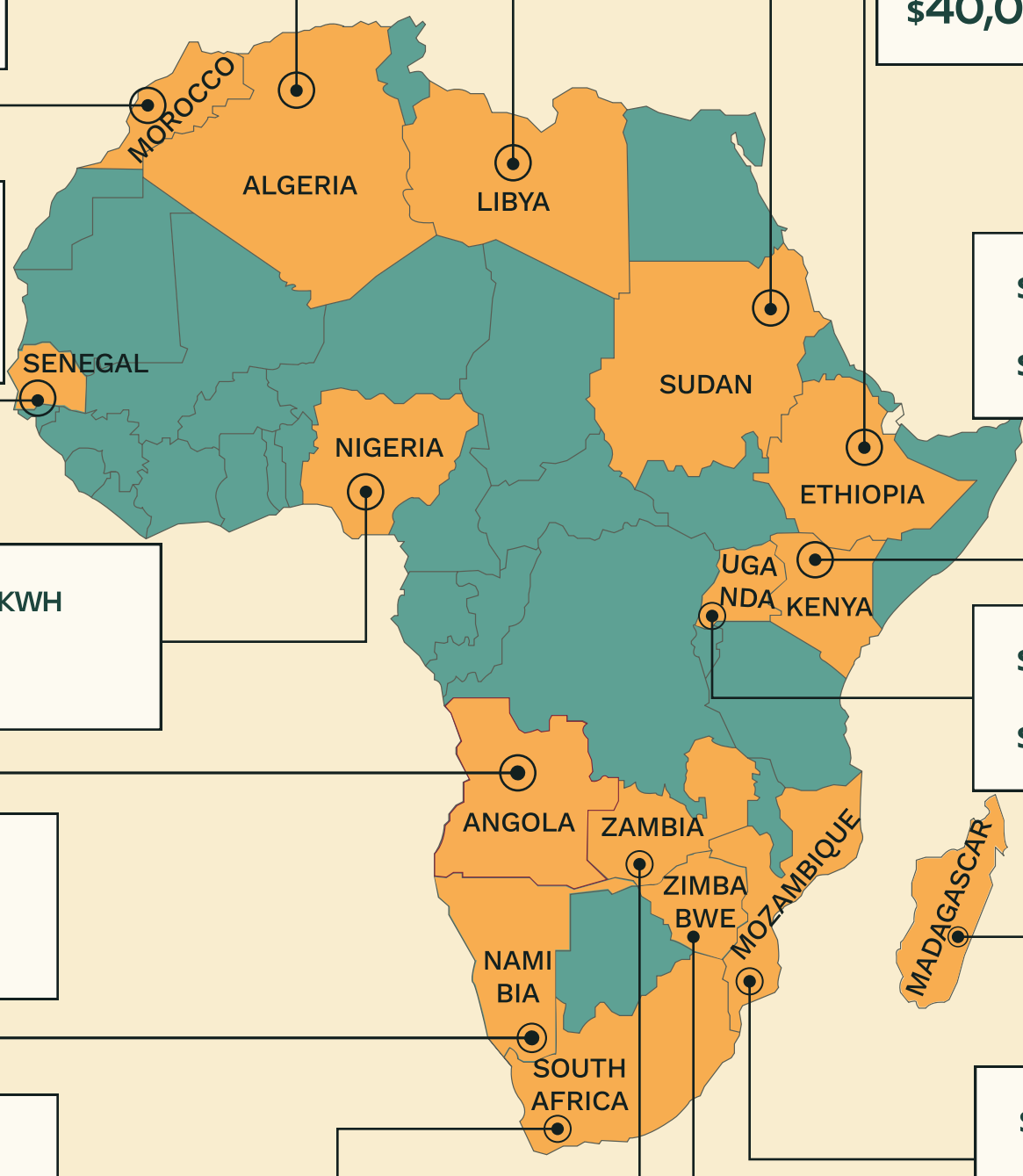
$0.033 /KWH (INDUSTRIAL)
$4,181.86 /BTC

$0.007 /KWH
$5,296.70 /BTC

$0.014 /KWH
$3,972.5 /BTC

$0.131 /KWH
NA (potential for much lower)

$0.0031 - $0.035 /KWH
$40,000/BTC



$0.3136 /KWH (INDUSTRIAL)
$122,490 /BTC

$0.161 /KWH (AVG)
$163,000 /BTC

$0.161 - 0.06 /KWH (INDUSTRIAL)
$9,269.22 /BTC

$0.090 /KWH
$114,540 /BTC

$0.013/KWH (AVG)
$8,607.13 /BTC

$0.161 /KWH (INDUSTRIAL)
$84,750 /BTC

$0.080 /KWH
$84,090/BTC

$0.1137/KWH
$95,340 /BTC

$0.076 - $0.10 /KWH (INDUSTRIAL)
EXCEED **$122,000/BTC**

$0.13 /KWH
$181,410 /BTC

$0.056/KWH (APPROX.)
NA (known for cheap hydro)

Economic and Social Impact

Bitcoin mining in Africa is demonstrating its capacity to drive substantial economic and social progress, extending beyond direct financial returns for operators.

Catalyst for Energy Infrastructure Development and Rural Electrification

Bitcoin mining can significantly enhance the economic viability of electricity projects, facilitating the provision of low-cost power to underserved areas.[48] Partnerships between miners and power companies, such as Gridless's collaboration with the Zengamina hydro-plant in Zambia, have proven transformative. The mining operation accounts for 30% of the plant's revenue, enabling it to keep electricity prices down for the local community.[12] This model has led to the electrification of additional households in Zambia and Malawi.[22] The co-location of small-scale Bitcoin data centers with renewables-based mini-grids offers a pathway to expand profitable electrification to communities without relying solely on charity or government subsidies.[13] For instance, in Virunga National Park, *the energy generated by the Bitcoin mine also supplies power to local households and contributes to reducing deforestation.*[27] The flexibility and high energy demand of Bitcoin mining can front-load the economics of energy projects, accelerating the deployment of new generation capacity and grid extensions, particularly in rural areas where traditional electrification methods are often cost-prohibitive. This directly contributes to achieving Sustainable Development Goal[7] (SDG7) – ensuring access to affordable, reliable, sustainable, and modern energy for all.

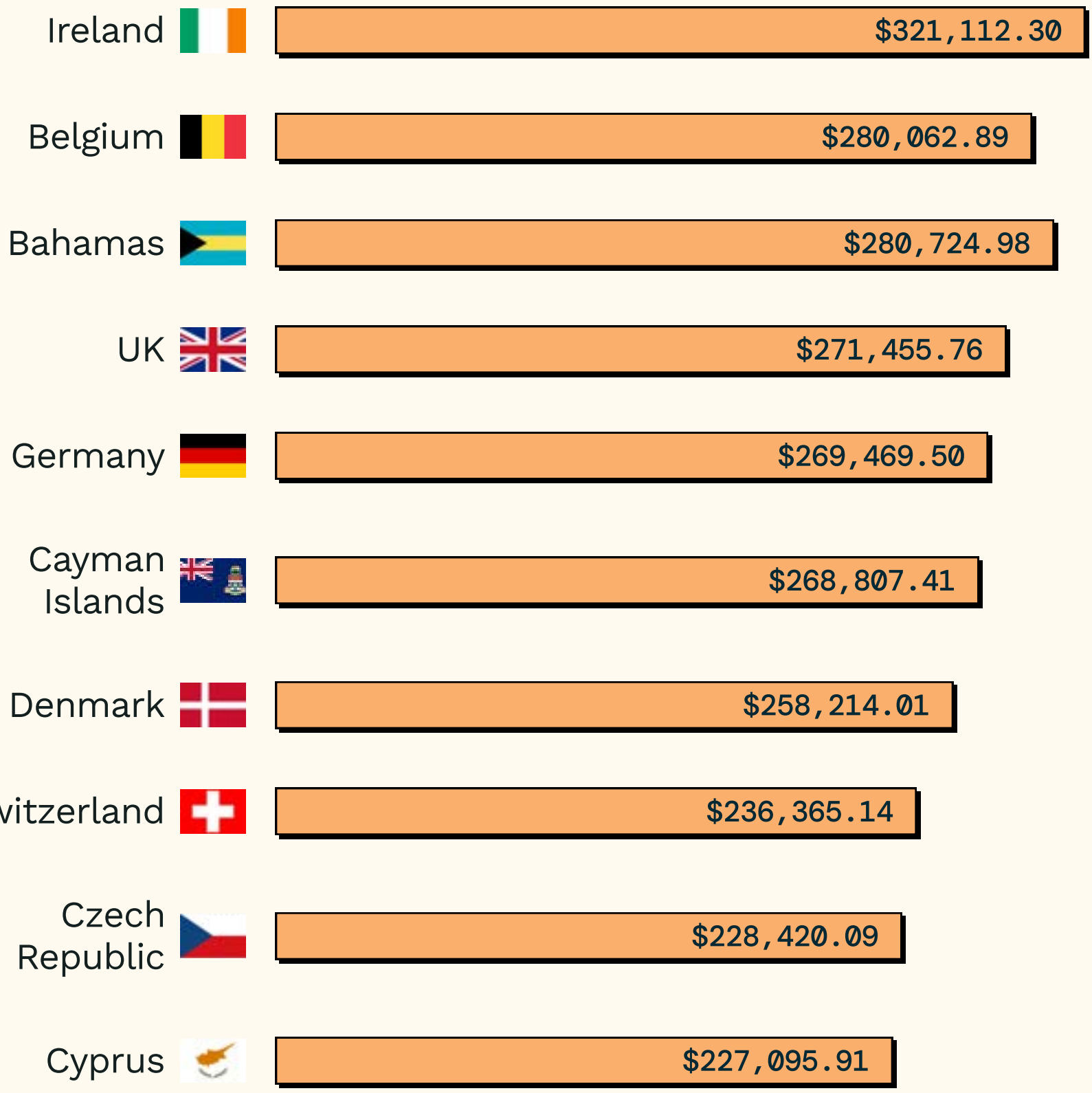
Job Creation and Skill Development

The expansion of Bitcoin mining operations across Africa is creating new employment opportunities and fostering skill development.[24] Companies like Trojan Mining in Nigeria are actively training local youth to manage mining setups, imparting valuable, lasting skills.[21] This industry also presents an opportunity to reverse the trend of "brain drain" by enabling individuals to enhance their technical skills, work remotely for global firms, and contribute to the development of local technology hubs.[48] This can foster a new generation of skilled workers in energy management, information technology, and blockchain technology, addressing youth unemployment and contributing to human capital development.

Foreign Exchange Generation

The sale of stranded renewable electricity to Bitcoin mining companies is generating substantial economic gains and much-needed foreign exchange for African nations.[13] Ethiopia, for example, earned over $55 million from electricity sales for Bitcoin mining in a 10-month period, representing 18% of Ethiopian Electric Power's total revenue.[8] This dollar-based revenue stream enhances the creditworthiness of African utilities and mitigates currency risks, reducing their dependence on high-interest loans.[9] This provides a stable, predictable, and hard-currency revenue stream for governments and utilities, which can be reinvested into public services or further infrastructure development, addressing a critical economic vulnerability for many African nations.

COMPARATIVE ELECTRICITY COSTS FOR BITCOIN MINING *(Least Profitable)*



Financial Inclusion and Community Empowerment

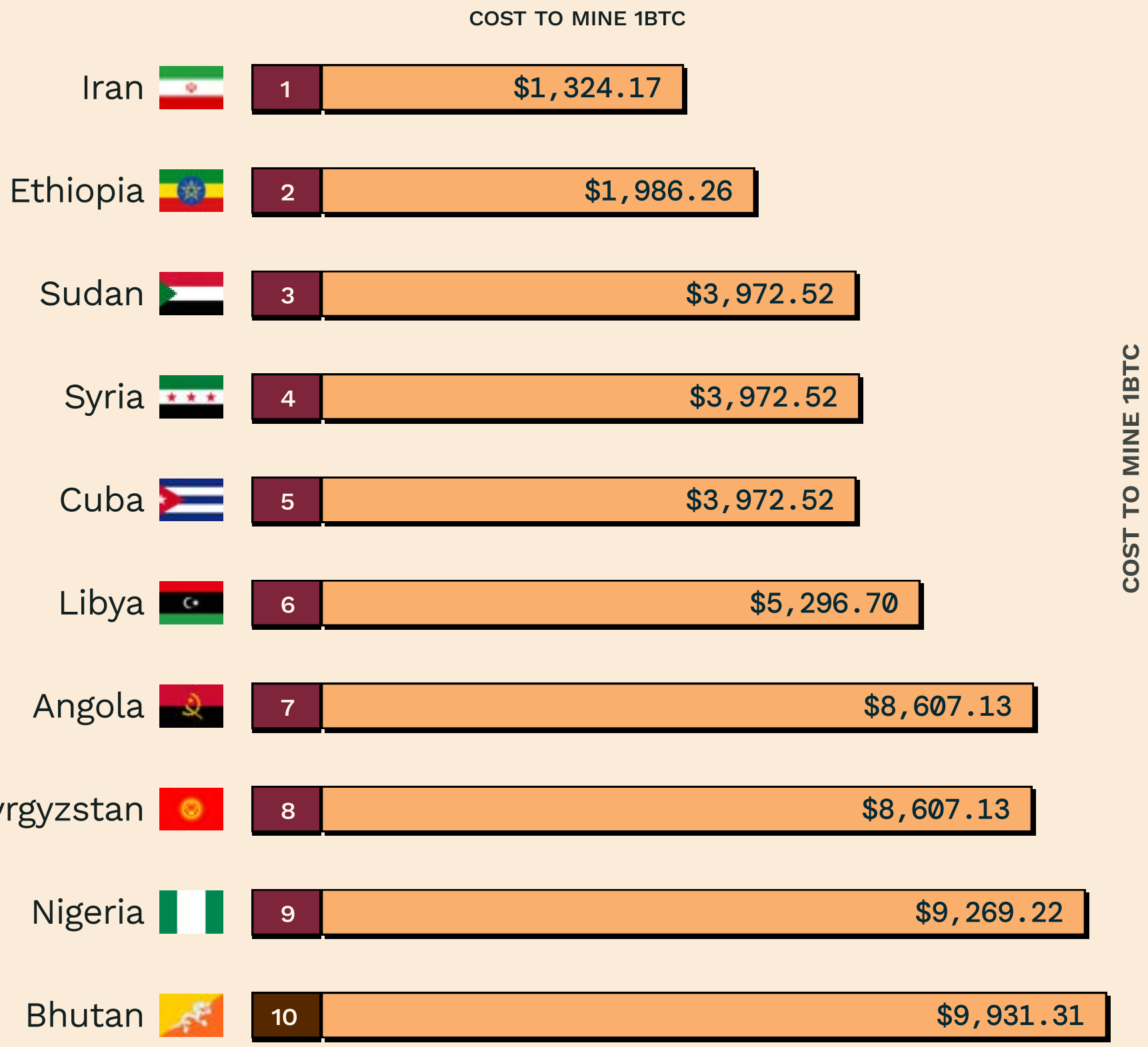
Bitcoin offers a viable pathway to financial services for populations with limited access to traditional banking infrastructure.[29] It empowers individuals and families by providing financial independence and improved livelihoods, serving as a medium of exchange, a tool for saving, and a source of earnings with greater purchasing power than local fiat currencies.[29] In countries experiencing hyperinflation, such as Zimbabwe, Bitcoin is increasingly perceived as a stable store of value and a hedge against depreciating local currencies.[29] By enabling electrification and economic activity, Bitcoin mining can indirectly foster greater financial inclusion and resilience within communities, particularly for Africa's large unbanked population.[24]

The integration of Bitcoin mining with sustainable energy development in Africa creates a powerful, self-reinforcing cycle. The continent possesses abundant, often unused, renewable energy.[13] Bitcoin miners require cheap, reliable power.[12] By acting as a consistent demand for this "stranded energy"[13], miners provide the economic impetus that makes renewable energy projects, especially mini-grids, economically viable.[12] This viability, in turn, attracts further investment, drives energy infrastructure development, and accelerates rural electrification.[9] Electrification then generates new economic opportunities, creates jobs, and improves the overall quality of life.[24] This dynamic establishes a positive feedback loop where the demand from Bitcoin mining fuels sustainable energy development, which then drives broader socio-economic progress, moving beyond traditional aid models.

A significant challenge for energy projects in Africa, particularly mini-grids, is the low initial consumption and long payback periods, which often deter commercial financiers without subsidies.[13] Bitcoin mining offers a high, predictable, and flexible base load demand.[17] This guaranteed demand substantially reduces the initial investment risk in energy generation, thereby improving the project's return on investment and making it more appealing to private capital.[13] This effectively transforms Bitcoin mining from a perceived "energy hog" into an "energy enabler" by providing the financial anchor necessary for energy infrastructure development.

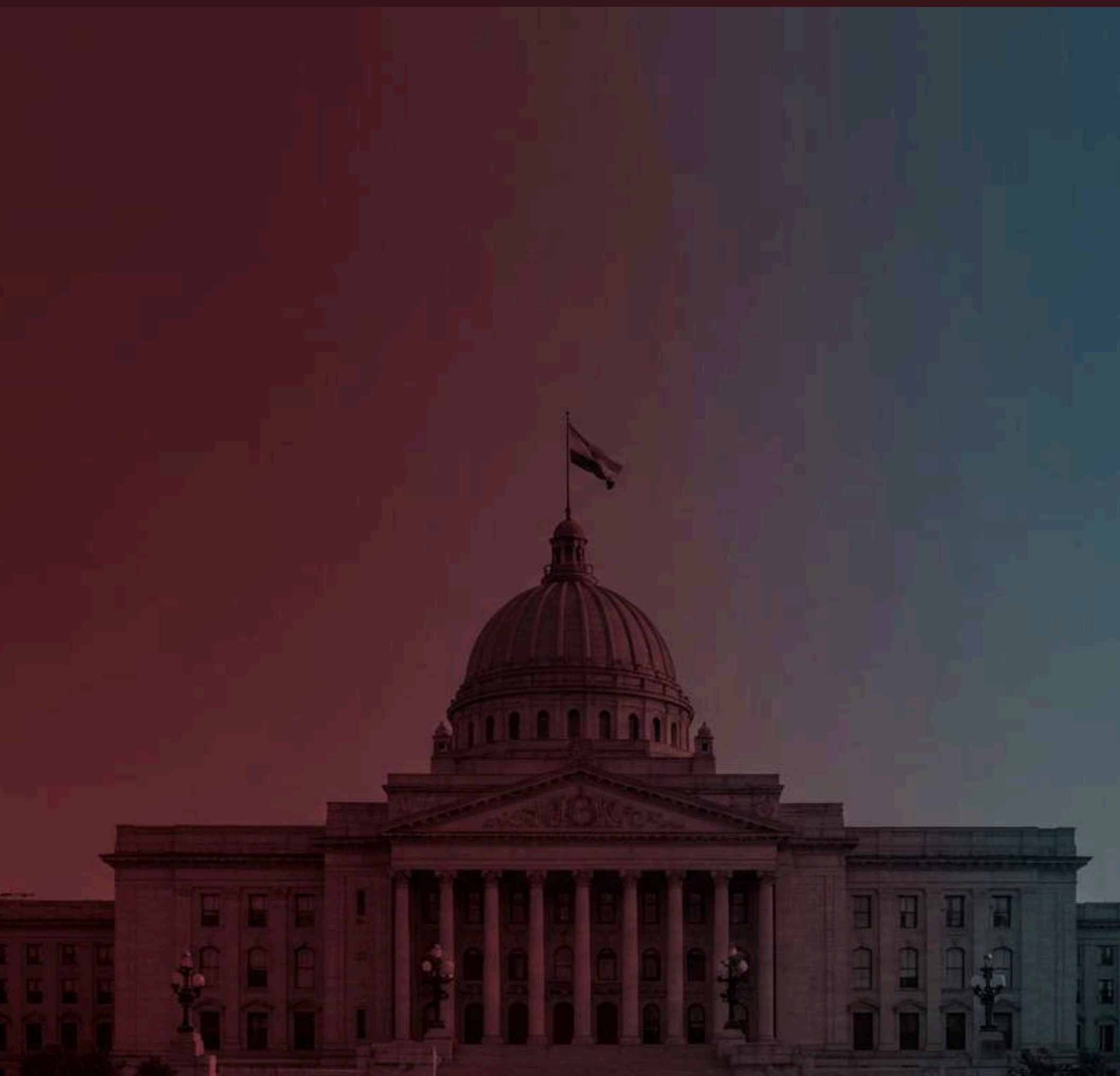
Moreover, the growing presence of Bitcoin mining in Africa is becoming a strategic element in broader geopolitical dynamics. The United States, for instance, is positioning itself as a leader in Bitcoin production and is actively connecting American investors to opportunities in Africa.[9] This strategy aims to advance US foreign policy interests by offering African nations a trusted partner in building energy infrastructure, promoting job creation, and countering the growing economic influence of other global powers like China on the continent.[9] This suggests that Bitcoin mining in Africa is not solely a commercial endeavor but also a strategic play in the global competition for influence and resource access, leveraging the concept of "American-made Bitcoin".[9]

COMPARATIVE ELECTRICITY COSTS FOR BITCOIN MINING *(Most Profitable)*



5.

Challenges & *Risks*



Despite the significant opportunities, Bitcoin mining in Africa faces a complex array of challenges, ranging from regulatory ambiguities to operational hurdles and environmental concerns. Addressing these issues is crucial for the sustainable growth of the industry on the continent.

Regulatory Uncertainty and Policy Evolution

The regulatory landscape for cryptocurrencies across Africa is a patchwork of varied stances, creating uncertainty for investors and operators. While Africa is one of the fastest-growing crypto markets globally, only about a quarter of Sub-Saharan African countries formally regulate crypto, with two-thirds having implemented some form of restrictions.[50] Six countries—Cameroon, Ethiopia (for transactions), Lesotho, Sierra Leone, Tanzania, and the Republic of Congo—have explicitly banned crypto.[50] Angola recently criminalized crypto mining, citing concerns about energy consumption and environmental impacts.[51] Conversely, the Central African Republic initially adopted Bitcoin as legal tender but later repealed this measure.[50]

However, there are signs of evolving and more pragmatic regulatory frameworks in key nations. Ethiopia, despite its central bank's ban on cryptocurrency transactions, has granted licenses for Bitcoin mining operations since 2022, categorizing them under "data center and cloud services".[34] In Nigeria, the Investments and Securities Act (ISA) 2025 has officially recognized cryptocurrencies as an asset class and explicitly placed Virtual Asset Service Providers (VASPs) under the regulatory purview of SEC Nigeria, ending previous uncertainties.[29] South Africa has classified crypto assets as financial products under the Financial Advisory and Intermediary Services Act (FAIS), requiring Crypto Asset Service Providers (CASPs) to obtain licenses and adhere to Anti-Money Laundering (AML) and Counter-Terrorism Financing (CFT) regulations, including the Travel Rule.[12] Kenya currently lacks clear crypto-specific regulations but is actively consulting with Marathon Digital to develop a comprehensive framework.[33] Governments are attempting to strike a balance between harnessing the economic benefits and innovation potential of cryptocurrencies and managing inherent risks such as money laundering, illicit financial flows, and potential impacts on financial stability.[29] The International Monetary Fund (IMF) emphasizes the necessity of robust regulations to minimize risk while maximizing innovation.[50] A particular challenge lies in ensuring that African nations fully benefit from the economic activity generated by mining. While Ethiopia offers some of the lowest mining costs, the country may not be fully benefiting from its natural resources due to minimal revenue capture and the absence of a well-defined regulatory framework for taxation.[39] This concern resonates with broader issues of tax avoidance observed in Africa's traditional mining sector.[50] The fragmented regulatory landscape creates uncertainty and risk for investors, and the challenge lies in developing clear, consistent, and forward-looking policies that both attract investment and protect national interests.

Operational and Technological Hurdles

Operating Bitcoin mining facilities in Africa, particularly in remote areas, presents several significant operational and technological challenges.

Reliability of Electricity Supply

A primary hurdle is the inconsistent and unreliable electricity supply across many African countries. Frequent power outages and shortages can severely impact the profitability and operational continuity of energy-intensive mining operations.[23] For instance, approximately 43% of Nigerians lack steady electricity access.[21]

Internet Connectivity

A basic internet connection is fundamental for Bitcoin mining operations.[9] However, unreliable internet connectivity, especially in remote and rural areas, poses a significant infrastructure challenge.[2] Efforts to address this include the partnership between Airtel Africa and SpaceX to introduce Starlink's high-speed satellite internet services across the continent, aiming to enhance connectivity for businesses and communities, particularly in underserved regions.[61]

Logistics and Supply Chain for Specialized Hardware

Bitcoin mining relies heavily on specialized hardware known as Application-Specific Integrated Circuits (ASICs).[1]

Heat Dissipation in Hot Climates

Mining machines generate an enormous amount of heat, which, if not properly managed, can significantly reduce their lifespan and efficiency.[31] While traditional air-cooled setups are common, advanced cooling technologies like immersion cooling (submerging hardware in dielectric fluid) offer superior efficiency and productivity, particularly in hot climates.[54] Africa Data Centres is deploying self-cooling racks in its facilities in South Africa to address the rising power and cooling challenges driven by the increasing demand for artificial intelligence (AI) and big data workloads.[64] While Africa offers the advantage of cheap energy, the existing infrastructure deficit necessitates substantial investment in grid stability, internet backbone, and specialized logistics, or the implementation of innovative off-grid solutions.

Environmental and Social Concerns

There is a need to educate policymakers and regulators about the environmental benefits of Bitcoin mining, and also bring them up to date with the latest data and studies that reveal that much of the first generation of Bitcoin environmental impact research has now been superceded with more reliable studies.

Energy Consumption and Carbon Footprint

Bitcoin mining is an energy-intensive process, consuming significant amounts of electricity globally. For instance, the global Bitcoin mining network consumed 173.42 Terawatt-hours (TWh) of electricity during 2020-2021, an amount comparable to Pakistan's total energy consumption.31 According to Cambridge’s 2025 study, sustainable energy now makes up 52.4% of Bitcoin’s overall energy mix, while coal accounts for just 8.9%. While concerns about energy consumption remain, the growing share of renewables signals meaningful progress toward sustainability in the industry.[79]

Perception of Competing with Local Needs

The substantial power usage of Bitcoin mining is often perceived as competing with Africa's limited electrification access.[1] However, this is a misunderstanding. Bitcoin mining is a non-rival energy user meaning it can operate on stranded, surplus, or otherwise unused energy sources. Rather than competing with households or hospitals for power, miners often help unlock underutilized energy by providing revenue to power producers, particularly in remote or off-grid areas.[84] In Kenya, for example, Gridless partners with

households or hospitals for power, miners often help unlock underutilized energy by providing revenue to power producers, particularly in remote or off-grid areas.[84] In Kenya, for example, Gridless partners with mini-grid developers to stabilize energy demand and reduce costs for rural communities. In Ethiopia, mining activity has supported the expansion of transmission infrastructure by utilizing previously unmonetized hydropower capacity. Even in mature energy markets, such as Texas, Bitcoin miners have demonstrated their ability to shut down during grid stress — acting as flexible, controllable loads that enhance grid reliability.

E-waste

The commonly cited figure that Bitcoin mining generates around 30,000 tonnes of electronic waste annually — mainly from specialized ASIC hardware, was based on a was based on a commentary by de Vries. However, this estimate has since been debunked. Cambridge's 2025 report shows the real number is much lower, with a maximum of around 2,300 tonnes.[79] While concerns persist that Bitcoin mining may strain public energy infrastructure, these claims are increasingly challenged by emerging research. A growing body of peer-reviewed and institutional studies shows that, when properly integrated,

Bitcoin mining can enhance grid reliability and reduce infrastructure stress, particularly in regions with underutilized or stranded energy resources.

- A whitepaper from energy experts at **Duke University** concluded that Controllable Load Resources, such as Bitcoin mining, can stabilize electrical grids and delay the need for expensive infrastructure upgrades[80].
- **Lai et al.** found that Bitcoin mining can help “balance the electrical grid”[81].
- **Ibañez et al.** concluded that Proof-of-Work mining can offer ancillary services vital to grid stability[82].
- **Menati et al.** highlighted the role of mining flexibility in ensuring power system reliability, noting it is “not detrimental” even at scale[83].

These findings suggest that, rather than being a burden on energy systems, Bitcoin mining — when deployed strategically — can serve as a valuable tool for grid stability and energy development in emerging markets.

Risks of Fraud and Financial Illiteracy

The decentralized nature of digital currencies makes them vulnerable to fraudulent activities Interpol's Operation Serengeti, for example, uncovered $193 million in losses from crypto-related fraud across 19 African countries.[29] A lack of financial literacy among potential users poses a significant barrier to widespread adoption and makes individuals susceptible to scams and fraudulent schemes.[13]

While some African operations, such as Phoenix Group's use of 90% hydropower in Ethiopia[19] and Virunga National Park's net-zero mine [27], are lauded for their sustainability, the overall perception of the industry and the potential for unsustainable practices remain a significant risk. Addressing these concerns through transparent reporting, strict environmental standards, and genuine community engagement is crucial for the long-term viability and social acceptance of Bitcoin mining in Africa.

The energy landscape in Africa presents a paradox: a severe energy deficit, with 600 million people lacking electricity[1], yet vast untapped renewable energy resources.[4] Bitcoin mining highlights this paradox by offering a mechanism to monetize the "stranded" abundance.[13] The fundamental problem is not merely generating power, but rather distributing it effectively and ensuring its economic viability. Bitcoin mining, by providing a consistent load, helps bridge this gap, but it also accentuates existing energy inequality if its deployment is not managed carefully and equitably.[58]

African governments are navigating a complex regulatory tightrope. Initial reactions often involved outright bans or strict restrictions due to concerns over money laundering and financial instability.[50]

However, in key economies like Ethiopia, Nigeria, and South Africa, more nuanced and pragmatic regulatory approaches are emerging.[12] This evolution reflects a complex balancing act: embracing the economic benefits and innovation potential of cryptocurrencies [29] while simultaneously mitigating risks such as fraud, illicit financial flows, and potential impacts on monetary policy.[29] The evolving nature of these regulations creates a degree of uncertainty but also presents opportunities for proactive engagement and collaboration between industry and government.

The global environmental concerns surrounding Bitcoin mining, particularly its carbon, water, and e-waste footprints [16], are

particularly sensitive in Africa, where resource scarcity and pressing development needs are acute.

While certain African operations are commended for their high sustainability standards, such as Phoenix Group's reliance on hydropower [12] and Virunga's net-zero mine [27], the industry's overall reputation can still be a barrier to broader acceptance.[1] This situation underscores the imperative for "responsible mining" practices that go beyond mere compliance. Such practices must prioritize the exclusive use of renewable energy, actively minimize environmental impact, and demonstrably contribute to local community development, thereby fostering genuine social and environmental stewardship.

AFRICAN COUNTRIES' REGULATORY STANCE ON CRYPTOCURRENCY MINING (2025)

COUNTRY	OVERALL CRYPTO STATUS	MINING SPECIFIC STATUS	KEY REGULATORY BODY/LEGISLATION	NOTEWORTHY REGULATIONS/STANCE
Ethiopia	Banned (for transactions)	Permitted (licensed)	National Bank of Ethiopia (NBE), Information Network Security Agency (INSA), Ethiopian Investment Commission (EIC)	Crypto mining permitted since 2022, categorized under "data center and cloud services"; requires foreign currency payment for electricity; income tax applies; offers tax holidays [34]
Nigeria	Legal (asset class)	Permitted (regulated)	Securities and Exchange Commission (SEC) Nigeria, Central Bank of Nigeria (CBN)	ISA 2025 recognizes crypto as asset class, VASPs under SEC purview; CBN lifted ban on banks servicing crypto providers; AML/KYC measures [29]
South Africa	Legal (asset class)	Permitted (regulated)	Financial Sector Conduct Authority (FSCA), Financial Intelligence Centre (FIC), South African Reserve Bank (SARB)	Crypto assets classified as financial products under FAIS; CASPs require FSP license; adherence to AML/CFT, Travel Rule (effective Apr 2025); over 60 platforms applied for licenses [12]

COUNTRY	OVERALL CRYPTO STATUS	MINING SPECIFIC STATUS	KEY REGULATORY BODY/LEGISLATION	NOTEWORTHY REGULATIONS/STANCE
Kenya	Unclear (no specific regulation)	Permitted (evolving)	Capital Markets Authority (CMA), Central Bank of Kenya (CBK)	No crypto-specific regulations, but existing laws apply; President Ruto consulting Marathon Digital to develop framework; KenGen invites miners to use geothermal [25]
Angola	Legal (formerly legal tender, now repealed)	Unclear	Bank of Central African States (BEAC)	Briefly adopted Bitcoin as legal tender in 2022, but repealed in April 2023; BEAC banned crypto for financial transactions in CEMAC region [50]
Cameroon, Lesotho, Sierra Leone, Tanzania, Republic of Congo	Banned	Banned	Various central banks/ governments	Explicit bans on crypto [50]
Zimbabwe	Unknown (implicit ban lifted by court, but contested)	Unclear	Reserve Bank of Zimbabwe	Banks ordered to stop processing transactions (implicit ban), but High Court lifted ban; off-grid solar mining operations exist 3

6.

Future Outlook & *Emerging Trends* (2024-2025)

The trajectory of Bitcoin mining in Africa over the next five years indicates significant expansion, driven by favorable economic conditions, technological advancements, and evolving policy landscapes.

Growth Projections

Africa's contribution to the global Bitcoin hash rate is projected to continue its upward trend. Ethiopia alone is anticipated to increase its share to approximately 7% of the global hash rate by the end of 2025, with the potential to scale its domestic mining operations to 1 GW.[7] Overall, Africa's hash rate share is expected to grow, primarily fueled by the increasing utilization of renewable energy sources.[8]

The broader Middle East and Africa cryptocurrency mining market is projected to grow at a Compound Annual Growth Rate (CAGR) of 5.7% from 2022 to 2029, reaching an estimated USD 196.62 million by 2029.[68] Within this, South Africa's Bitcoin mining hardware market alone is expected to reach US$72.3 million by 2030.[14]

Bitcoin price predictions also play a crucial role in shaping the industry's profitability and investment. Analysts suggest Bitcoin could reach $210,000 by the end of 2025[12] and potentially $1 million by 2030, largely driven by accelerating institutional adoption.[46] Such price appreciation directly enhances mining profitability, thereby incentivizing further investment and expansion in regions offering low energy costs, like Africa. The projections collectively indicate a significant expansion of Bitcoin mining activities across Africa, propelled by its cost advantages and the global industry's continuous demand for efficient power. This growth is intrinsically linked to the broader adoption of Bitcoin and increasing institutional interest.

Technological Convergence

The future of Bitcoin mining in Africa is increasingly defined by its convergence with other cutting-edge technologies.

AI and High-Performance Computing (HPC) Integration

Modern mining facilities are increasingly being designed for dual-use operations, simultaneously supporting Bitcoin mining and computationally intensive tasks such as AI training or scientific modeling.[9] This hybrid model offers the advantage of maximizing energy and hardware utilization while diversifying revenue streams.[33] Companies like g42 are already announcing significant deals in Kenya to utilize geothermal energy for AI processing.[34] Furthermore, advanced cooling solutions, such as self-cooling racks, are being deployed in African data centers to effectively manage the rising power and cooling challenges driven by AI and big data workloads.[64]

Advancements in ASIC Technology and Cooling Solutions

The industry continues to innovate rapidly in ASIC technology, with a progression towards smaller, more powerful, and energy-efficient chips (e.g., 4nm and 3nm, with 2nm on the horizon).[2] Concurrently, advanced cooling technologies like immersion cooling—submerging mining hardware in dielectric fluid—are becoming more prevalent to manage the immense heat generated by these machines and improve overall efficiency.[54]

Role of Satellite Internet

The expansion of satellite internet services, notably Starlink, across Africa is significantly enhancing connectivity for businesses and communities, particularly in remote and underserved areas.[61] This improved connectivity facilitates the deployment of "distributed data centers" powered by mini-grids in rural Africa, reducing reliance on traditional, often unreliable, grid connections.[23] The convergence of Bitcoin mining with AI and HPC represents a critical emerging trend. Bitcoin mining can serve as an anchor load for energy infrastructure, which can then be leveraged for other high-value computing applications, positioning Africa as a hub for future digital innovation. Improved connectivity will unlock the potential of even more remote energy sources.

Policy and Investment Trajectories

The policy and investment landscape for Bitcoin mining in Africa is expected to become more structured and collaborative.

Clearer Regulatory Frameworks and Incentives

A discernible trend towards formalizing cryptocurrency regulations is evident in countries like Nigeria and South Africa.[12] Governments may increasingly offer incentives such as tax holidays [34] and regulatory sandboxes [42] to attract and retain investment in the sector. This indicates a maturing approach to governance.

Increased Institutional Investment and Strategic Partnerships

Foreign investment, particularly from the United States and the UAE, is already a significant factor.[1] Strategic partnerships between international mining firms and African governments or utilities, exemplified by the collaboration between Marathon Digital and Kenya, are anticipated to increase.[24] Public-private cooperation is recognized as crucial for co-investing in digital infrastructure and bridging existing funding gaps.[42]

Focus on Sustainable and Community-Centric Mining Models

The emphasis on utilizing renewable energy sources and ensuring a positive community impact will intensify.[9] Models like Gridless, which directly link mining revenue to rural electrification and local development, are expected to gain further traction and support.[12] The Green Africa Mining Alliance serves as a prominent example of this commitment to responsible and impactful mining practices.[24] The future will likely see a more structured and collaborative environment, with governments refining policies to maximize economic benefits while mitigating risks, thereby attracting more sophisticated institutional capital that prioritizes both profitability and sustainability.

Africa is poised to become a "dual-use" digital infrastructure hub. Bitcoin mining requires substantial energy and data center infrastructure.[13] Simultaneously, the burgeoning fields of AI and HPC also demand immense computational power and energy.[3] Africa's abundant and cost-effective renewable energy, coupled with its pressing need for digital transformation, positions it perfectly to develop infrastructure that serves multiple purposes. Bitcoin mining can provide the foundational base load and initial profitability, thereby

enabling the subsequent expansion into AI and other high-performance computing applications.[9] This strategic approach allows African nations to bypass traditional infrastructure development pathways and emerge as key players in the global digital economy, evolving beyond mere energy suppliers to become significant compute providers.

The initial, often reactive, responses of bans or strict restrictions on cryptocurrencies [50] are gradually giving way to more nuanced and pragmatic regulatory approaches in key African economies such as Ethiopia, Nigeria, and South Africa.[12] This shift is fundamentally driven by the undeniable economic benefits that Bitcoin mining offers, particularly in terms of foreign exchange generation and infrastructure development.[13] The prevailing trend suggests that governments are learning to strategically leverage the benefits of cryptocurrencies rather than simply prohibiting their associated risks. This will likely lead to the development of more comprehensive regulatory frameworks that integrate mining into national economic strategies, potentially including taxation and licensing incentives.

Countries with abundant, cheap, and often stranded energy resources, like Ethiopia, are effectively "exporting" this energy in the form of Bitcoin.[13] Instead of investing in costly transmission lines or developing energy-intensive industries for traditional exports, these nations can monetize their energy resources directly through Bitcoin mining. Bitcoin, being a globally liquid and easily transferable digital asset [9], allows these energy-rich but infrastructure-poor nations to participate in the global economy, bypassing traditional trade barriers and generating much-needed hard currency. This creates a novel paradigm for economic engagement and resource utilization.

PROJECTED BITCOIN MINING HASH RATE SHARE FOR KEY AFRICAN NATIONS (2025-2030)

COUNTRY	CURRENT HASH RATE SHARE (DEC 2024)	PROJECTED HASH RATE SHARE (END 2025)	PROJECTED HASH RATE SHARE (2030)	KEY GROWTH DRIVERS
Ethiopia	**2.5%** [8]	**~7%** [7]	Significant growth expected	Abundant hydropower, low electricity costs, government foreign currency incentive, AI/ mining infrastructure investment 12
Nigeria	Growing, but specific share not cited	Continued growth	Substantial growth expected	High crypto adoption, off-grid renewable solutions, new hydro projects, regulatory clarity [29]
Kenya	Growing, but specific share not cited	Continued growth	Significant growth expected	Crypto assets classified as financial products under FAIS; CASPs require FSP license; adherence to AML/CFT, Travel Rule (effective Apr 2025); over 60 platforms applied for licenses [12]
DRC	Growing, but specific share not cited	Continued growth	Moderate growth expected	Hydroelectric potential, successful Virunga National Park model, focus on community impact [2]

COUNTRY	CURRENT HASH RATE SHARE (DEC 2024)	PROJECTED HASH RATE SHARE (END 2025)	PROJECTED HASH RATE SHARE (2030)	KEY GROWTH DRIVERS
South Africa	Small, but growing	Moderate growth	Moderate growth expected	Clear regulatory framework, existing tech infrastructure, green data center market growth [12]
Overall Africa	3% [8] 	Increasing	Substantial increase	Abundant stranded renewable energy, competitive electricity costs, increasing institutional interest, evolving pragmatic regulations [1]

7.

Recommendation
For Stakeholders

To foster sustainable growth and maximize the transformative benefits of Bitcoin mining in Africa, tailored strategies are necessary for various stakeholder groups.

Governments and regulatory bodies should move beyond prohibitive stances to establish clear, consistent, and comprehensive legal and tax guidelines for Bitcoin mining. This approach should draw lessons from countries like Ethiopia, Nigeria, and South Africa, which are developing pragmatic frameworks.[12] It may be effective to incentivize sustainable practices by offering tax breaks, subsidies, or other benefits to mining operations that exclusively utilize renewable energy and demonstrate a positive environmental footprint.[4] Policymakers should prioritize local benefits by implementing policies that ensure a portion of mining revenues or profits are reinvested into local communities for infrastructure development, job training, and social programs.[24] Exploring mechanisms for revenue sharing with local energy providers, as seen in Zambia, can further enhance community acceptance and economic impact.[12] Fostering public-private partnerships is essential for co-investing in energy and digital infrastructure, leveraging private capital for public good and accelerating development.[9] Finally, investing in public education campaigns is vital to demystify Bitcoin, raise awareness about associated risks (e.g., scams), and equip citizens with the knowledge to participate safely and confidently in the digital economy.[29]

For Investors and Mining Operators

Investors and mining operators should strategically focus on sites with abundant, cheap, and ideally stranded renewable energy sources such as hydro, solar, and geothermal power. This ensures long-term profitability and alignment with growing Environmental, Social, and Governance (ESG) demands.1 A critical element for success is embracing community engagement.

This involves developing operational models that directly benefit local communities through job creation, skill transfer, and tangible contributions to rural electrification and social services.[12]
Investment in robust infrastructure is also paramount; this includes deploying advanced cooling solutions, such as immersion cooling for hot climates, and exploring satellite internet for reliable operations in remote areas.[54] Proactive engagement with local governments and regulatory bodies is necessary to understand evolving policies, advocate for favorable frameworks, and ensure full compliance.[12] Furthermore, exploring the design of dual-use facilities that can support both Bitcoin mining and other high-performance computing applications like AI can diversify revenue streams and maximize infrastructure utilization.[9]

For Local Communities and Development Partners

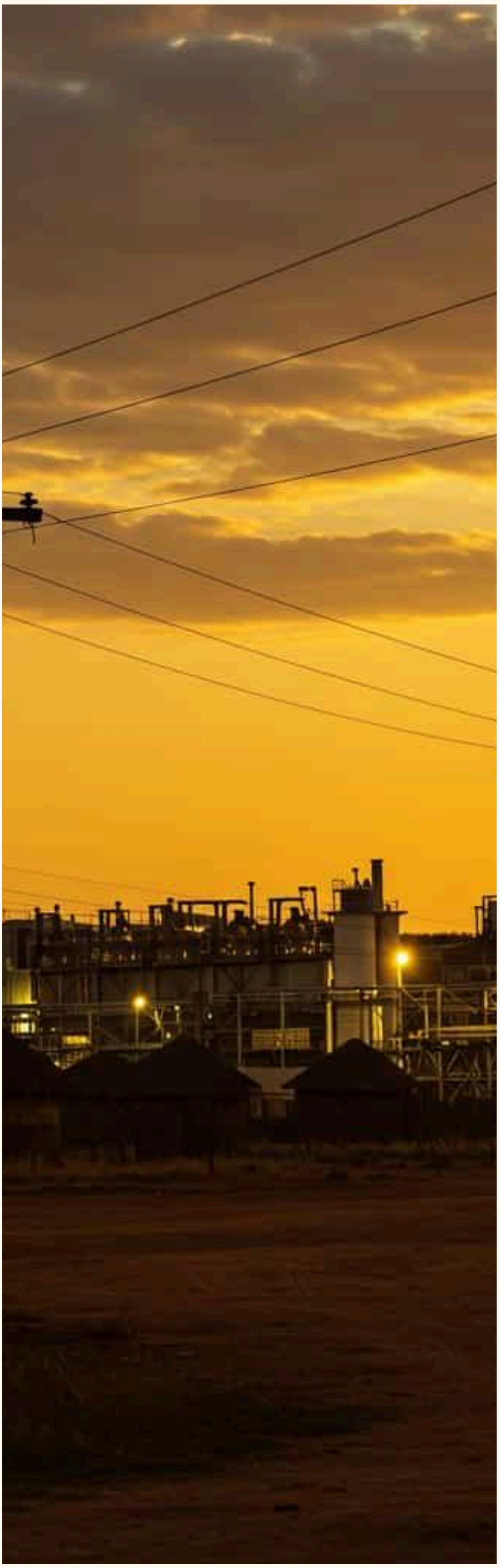
Local communities and development partners should actively advocate for equitable benefit sharing, ensuring that community interests are well-represented in agreements with mining companies. This includes advocating for fair revenue shares, local employment opportunities, and direct investment in infrastructure development.[12] Supporting skill development initiatives is crucial; this involves partnering with mining companies and educational institutions to create training programs that equip local youth with skills relevant to the digital and energy sectors, thereby addressing youth unemployment and fostering human capital.[24]

Leveraging new electricity access enabled by mining operations for broader development is also key, utilizing power to improve healthcare (e.g., refrigeration), education, and local economic activities.[24]

Finally, working to increase financial literacy regarding Bitcoin can empower communities to safely participate in the digital economy and protect themselves from scams.[29]

The success of Bitcoin mining in Africa is not solely dependent on the profitability for miners or the revenue for governments. It hinges on the creation of a "shared value" ecosystem where the economic incentives of mining are harmoniously aligned with the development goals of African nations.[13] This necessitates a shift from purely transactional relationships to long-term partnerships that prioritize mutual benefit, community empowerment, and environmental stewardship. The recommendations presented reflect this holistic view, aiming to foster a collaborative environment where all stakeholders contribute to and benefit from the growth of this nascent industry.

While individual mini-grids benefit significantly from Bitcoin mining, the long-term vision for Africa's energy security and economic integration involves broader regional grid interconnection.[12] Bitcoin mining, by demonstrating and proving the economic viability of new generation capacity even in remote areas, could indirectly accelerate investment in transmission infrastructure that eventually links these isolated power sources to broader national or regional grids. This could contribute to a more robust and interconnected African energy market, enhancing energy security and facilitating cross-border energy trade.



8.

Conclusion

Africa stands at a pivotal juncture, poised to become a global leader in sustainable Bitcoin mining. The continent's immense, untapped renewable energy resources, particularly its abundant hydropower, solar, wind, and geothermal potential, offer an unparalleled competitive advantage. This natural endowment, coupled with the industry's ability to monetize "stranded energy" and generate much-needed foreign exchange, positions Bitcoin mining as a significant catalyst for energy infrastructure development and rural electrification across the continent. The economic and social benefits, including job creation, skill development, and enhanced financial inclusion, underscore the transformative potential of this sector when strategically integrated into national development agendas.

While challenges persist, including a fragmented regulatory landscape, operational hurdles related to infrastructure deficits, and environmental concerns, the trajectory indicates a maturation of the industry. Governments are increasingly adopting pragmatic regulatory approaches, moving from outright bans towards frameworks that seek to harness the economic benefits while mitigating risks. This evolving policy environment, coupled with growing institutional investment and strategic partnerships, is fostering a more structured and collaborative ecosystem.

Looking to 2030, the convergence of Bitcoin mining with artificial intelligence and high-performance computing is set to establish Africa as a dual-use digital infrastructure hub, leveraging its energy resources to power not only cryptocurrency operations but also the broader digital economy. The ability of energy-rich but infrastructure-poor nations to effectively "export" their energy via Bitcoin represents a new paradigm for global economic participation.

Ultimately, the future of Bitcoin mining is intrinsically tied to Africa's energy potential and its commitment to innovation and sustainable development. By prioritizing responsible practices, fostering collaborative partnerships, and developing clear, forward-looking policies, Africa can leverage Bitcoin mining to drive economic growth, enhance energy access, and solidify its position as a proactive and influential player in the global digital landscape. The opportunities far outweigh the challenges, making this a critical area for strategic focus and investment.

8.

References

References

[17] 2025. Qabas. Crypto in Libya — All You Should Know [FREE Consultation]. https://qbs.ly/our-expertise/crypto-in-libya

[18] February, 20,2025. Mara. The Economic Impact of Bitcoin Mining: Jobs, Investment, & Energy Stability. https://www.mara.com/posts/the-economic-impact-of-bitcoin-mining-jobs-investment-energy-stability

[19] April 2025. GEAPP. Leveraging AI and crypto to power Mission 300 and end energy poverty in Africa. https://energyalliance.org/ai-crypto-mission-300-energy-access

[21] May 1, 2025. The Cable. Bitcoin mining's bright surge in Nigeria: Your key to a crypto-powered tomorrow. https://www.thecable.ng/bitcoin-minings-bright-surge-in-nigeria-your-key-to-a-crypto-powered-tomorrow/

[22] Quantum Hash. https://quantumhash.co/

[23] April, 15, 2025. Global Energy Alliance for People and Planet. Leveraging AI and crypto to power Mission 300 and end energy poverty in Africa. https://energyalliance.org/ai-crypto-mission-300-energy-access/

[24] April,30,2025. Mango Digital Strategies. Can Africa Illuminate the Path to Sustainable Bitcoin Mining?. https://www.mangodigitalstrategies.com/post/can-africa-illuminate-the-path-to-sustainable-bitcoin-mining

[24] Charlene Fadirepo. May 7 2025. Mango Digital Strategies. Can Africa Illuminate the Path to Sustainable Bitcoin Mining?. https://www.mangodigitalstrategies.com/post/can-africa-illuminate-the-path-to-sustainable-bitcoin-mining

[25] December 06, 2022. Block. Gridless, a Bitcoin Mining Company in East Africa, Raises $2M in Funding Led by Stillmark and Block, Inc. https://block.xyz/inside/press-release-gridless-investment

[26] May 2024. CNBC Africa. Kenya's Treasury eyes bitcoin mining and regulation. https://www.cnbcafrica.com/media/6352417867112/kenyas-treasury-eyes-bitcoin-mining-and-regulation-/

[27] Mar 8, 2024. Cryptobriefing. Bitcoin mining fuels green energy and creates sustainable jobs in African national park: World Economic Forum. https://www.tradingview.com/news/cryptobriefing:ea1812f83094b:0-bitcoin-mining-fuels-green-energy-and-creates-sustainable-jobs-in-african-national-park-world-economic-forum/

[29] Bella Malcom. May, 7,2025. Africa Leadership Magazine. Crypto In Africa A Revolution Or a Risk. https://www.africanleadershipmagazine.co.uk/is-crypto-in-africa-a-revolution-or-a-risk/

[30] April, 27, 2025. Di Market. Understanding Growth Trends in Bitcoin Mining Market. https://www.datainsightsmarket.com/reports/bitcoin-mining-1365806

[31] March 2024. Africa Science. Ethiopia set to pioneer Bitcoin Mining In Africa. https://africasciencenews.org/ethiopia-set-to-pioneer-bitcoin-mining-in-africa

[32] May, 2025. CoinStats. Bitcoin Mining Grows in Africa as Analysts See BTC Doubling by Year End. https://coinstats.appnews/5673f881e90857efb4473a02cff517ec0b7240f0c5d52b00a5cf4bb38e824dcfBitcoin-Mining-Grows-in-Africa-as-Analysts-See-BTC-Doubling-by-Year-End/

[33] October 2021. Time. Why So Many Bitcoin Mining Companies Are Pivoting to AI. https://time.com/6993603/ai-bitcoin-mining-artificial-intelligence-energy-use/

[34] April 23 2025. Nralaw Office. Cryptomining in Ethiopia – Legal Outlook 2025. https://www.credenceresearch.com/report/africa-green-data-center-market

[35] August 2024. Binance Square. Bitcoin Mining Profitability Affected By Electricity Costs. https://www.binance.com/en/square/post/2024-08-05-bitcoin-mining-profitability-affected-by-electricity-costs-11748669470217

[36] December ,12,2024. Minerset. The Rise of Crypto Mining in Africa: Opportunities and Challenges. https://minerset.com/the-rise-of-crypto-mining-in-africa-opportunities-and-challenges/

[38] Liz Mills. December ,12,2024. Crypto Council For Innovation. Crypto in Nigeria – Surge in Adoption and Regulatory Shifts. https://cryptoforinnovation.org/crypto-in-nigeria-surge-in-adoption-and-regulatory-shifts/

[40] Paul Gerke. April 8, 2025. Factor this. Project Rosa: Where wind energy meets AI and Bitcoin mining. https://www.renewableenergyworld.com/wind-power/project-rosa-where-wind-energy-meets-ai-and-bitcoin-mining/

[41] May 15, 2025. Cointelegraph. Bitcoin mining 2025: Post-halving profitability, hashrate and energy trends. https://cointelegraph.com/news/bitcoin-mining-2025-post-halving-profitability-hashrate-and-energy-trends

[43] November 22, 2022. IMF blog. Africa's Growing Crypto Market Needs Better Regulations. https://www.imf.org/en/Blogs/Articles/2022/11/22/africas-growing-crypto-market-needs-better-regulations

[29] Bella Malcom. May, 7,2025. Africa Leadership Magazine. Crypto In Africa A Revolution Or a Risk. https://www.africanleadershipmagazine.co.uk/is-crypto-in-africa-a-revolution-or-a-risk/

[30] April, 27, 2025. Di Market. Understanding Growth Trends in Bitcoin Mining Market. https://www.datainsightsmarket.com/reports/bitcoin-mining-1365806

[31] March 2024. Africa Science. Ethiopia set to pioneer Bitcoin Mining In Africa. https://africasciencenews.org/ethiopia-set-to-pioneer-bitcoin-mining-in-africa

[32] May, 2025. CoinStats. Bitcoin Mining Grows in Africa as Analysts See BTC Doubling by Year End. https://coinstats.appnews/5673f881e90857efb4473a02cff517ec0b7240f0c5d52b00a5cf4bb38e824dcfBitcoin-Mining-Grows-in-Africa-as-Analysts-See-BTC-Doubling-by-Year-End/

[33] October 2021. Time. Why So Many Bitcoin Mining Companies Are Pivoting to AI. https://time.com/6993603/ai-bitcoin-mining-artificial-intelligence-energy-use/

[34] April 23 2025. Nralaw Office. Cryptomining in Ethiopia – Legal Outlook 2025. https://www.credenceresearch.com/report/africa-green-data-center-market

[35] August 2024. Binance Square. Bitcoin Mining Profitability Affected By Electricity Costs. https://www.binance.com/en/square/post/2024-08-05-bitcoin-mining-profitability-affected-by-electricity-costs-11748669470217

[36] December ,12,2024. Minerset. The Rise of Crypto Mining in Africa: Opportunities and Challenges. https://minerset.com/the-rise-of-crypto-mining-in-africa-opportunities-and-challenges/

[38] Liz Mills. December ,12,2024. Crypto Council For Innovation. Crypto in Nigeria – Surge in Adoption and Regulatory Shifts. https://cryptoforinnovation.org/crypto-in-nigeria-surge-in-adoption-and-regulatory-shifts/

[39] Feb 2025.nft Evening. Electricity Costs to Mine 1 Bitcoin at Home, Around the World. https://nftevening.com/bitcoin-mining-cost/

[40] Paul Gerke. April 8, 2025. Factor this. Project Rosa: Where wind energy meets AI and Bitcoin mining. https://www.renewableenergyworld.com/wind-power/project-rosa-where-wind-energy-meets-ai-and-bitcoin-mining/

[41] May 15, 2025. Cointelegraph. Bitcoin mining 2025: Post-halving profitability, hashrate and energy trends. https://cointelegraph.com/news/bitcoin-mining-2025-post-halving-profitability-hashrate-and-energy-trends

[42] March 2025. SSRN. Cryptocurrency Regulation in Africa: Advantages, Motivation, Regulatory Models, Challenges, Consequences, and Principles vs. Rules-Based Regulation. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5103105

[43] November 22, 2022. IMF blog. Africa's Growing Crypto Market Needs Better Regulations. https://www.imf.org/en/Blogs/Articles/2022/11/22/africas-growing-crypto-market-needs-better-regulations

[44] ecommons. Review of the Energy and Social Impact of Bitcoin Mining and Tran. https://ecommons.udayton.edu/cgi/viewcontent.cgi?article=1000&context=mee_wk_papers

[45] Oct 24 2023. UN. UN Study Reveals the Hidden Environmental Impacts of Bitcoin: Carbon is Not the Only Harmful By-product. https://live-unu-edu.pantheonsite.io/press-release/un-study-reveals-hidden-environmental-impacts-bitcoin-carbon-not-only-harmful-product

[46] April 2025. Cointegraph. Bitcoin could hit $210K in 2025, says Presto research head. https://cointelegraph.com/news/peter-chung-bitcoin-210k-prediction-institutional-adoption-2025

[48] April 29, 2024. Melanion Capital. Bitcoin Equities Talks Ep.28: Bitcoin in Africa – Empowering and Addressing Energy Poverty. https://melanion.com/podcast/bitcoin-equities-talks-ep-28-bitcoins-impact-in-africa-empowering-communities-and-addressing-energy-poverty-with-charlene-fadirepo-ceo-of-mango-digital-strategies/

[50] Patrick Utomi. January 28, 2025. Wilson centre. A New African Mining Sector? Trends in Mining, Infrastructure, and Investment for African Development. https://www.wilsoncenter.org/article/new-african-mining-sector-trends-mining-infrastructure-and-investment-african-development

[61] November 2024. African Business. Starlink's aggressive push in Africa keeps telcos on high alert. https://african.business/2024/11/technology-information/starlinks-aggressive-push-in-africa-keeps-telcos-on-high-alert#:~:text=In%20early%202024%20Africa's%20internet,or%20modifications%20to%20their%20device

[64] May 2025. Developing Telecoms. frica Data Centres deploys self-cooling rack technology. https://developingtelecoms.com/telecom-technology/energy-sustainability/18510-africa-data-centres-deploys-self-cooling-rack-technology.html#:~:text=The%20new%20solution%20also%20helps,energy%20efficiency%20and%20operational%20excellence.

[68] February 2022. Data Bridge. Middle East and Africa Cryptocurrency Mining Market – Industry Trends and Forecast to 2029. https://www.databridgemarketresearch.com/reports/middle-east-and-africa-cryptocurrency-mining-market

[76] December 2024. DigWatch. Ethiopia becomes a key player in Bitcoin mining. https://dig.watch/updates/ethiopia-becomes-a-key-player-in-bitcoin-mining#:~:text=The%20country's%20attractiveness%20to%20Bitcoin,leaders%20in%20the%20coming%20decades.

[77] October 5 2024. The Cryptonomist. What Are the Costs for Mining Bitcoin? https://en.cryptonomist.ch/2024/10/05/what-are-the-costs-for-mining-bitcoin

[78] February 3, 2025. nft evening. Electricity Costs to Mine 1 Bitcoin at Home, Around the World. https://nftevening.com/bitcoin-mining-cost/

[79] 28 April 2025. University Of Cambridge. Cambridge study: sustainable energy rising in Bitcoin mining. https://www.jbs.cam.ac.uk/2025/cambridge-study-sustainable-energy-rising-in-bitcoin-mining

[80] 2023. Duke University Nicholas Institute. Rethinking Load Growth: Bitcoin Mining and Grid Resilience. https://dukespace.lib.duke.edu/bitstreams/901dc179-dea1-420c-a7e3-c44b3f85ce9e/download

[81] October 27,2023. ACS Publications. From Mining to Mitigation: How Bitcoin Can Support Renewable Energy Development and Climate Action. https://pubs.acs.org/doi/10.1021/acssuschemeng.3c05445

[82] October 27,2023. MDPI. Bitcoin's Carbon Footprint Revisited: Proof of Work Mining for Renewable Energy Expansion. https://www.mdpi.com/2078-1547/14/3/35

[82] 8 August 2023. MDPI. Bitcoin's Carbon Footprint Revisited: Proof of Work Mining for Renewable Energy Expansion. https://www.mdpi.com/2078-1547/14/3/35

[83] June 2023. ScienceDirect. High resolution modeling and analysis of cryptocurrency mining's impact on power grids: Carbon footprint, reliability, and electricity price. https://sciencedirect.com/science/article/pii/S266679242300015X

[84] 2022. Crypto World. Crypto mines help ERCOT keep renewable energy operational. https://www.youtube.com/watch?v=gKnRfDeFgr0&t=213s

[89] February 2025. Nemo Semret. OnThe Real Cost Of Mining Bitcoin. https://nemozen.semret.org/2025/02/on-real-cost-of-bitcoin-mining-and.html