MACRO PICTURE:

Rethinking Bitcoin Valuation: Liquidity, Power Law, and Energy-Based Models

By

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Nato Balavadze

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Executive Summary

1. The Role of Global Liquidity (M2)

- Our previous analysis on the fair valuation of Bitcoin argued that global liquidity, measured through Global M2, has historically acted as the primary indicator of Bitcoin price cycles, with expansions during periods such as post-2008 QE and the COVID-19 stimulus aligning with major bull markets and contractions often preceding corrections.

- Bitcoin responds to changes in liquidity with a notable delay of roughly 10–12 weeks, illustrating that it functions as a macro-sensitive asset whose long-term behavior is shaped by central bank policy, debt conditions, and investor sentiment rather than by crypto-specific narratives alone.

2. The Role of US Dollar Strenght

- New evidence suggests Bitcoin is influenced by two interacting forces, where liquidity provides slow, sustained upward pressure while Dollar strength exerts fast, immediate downward pressure, creating a push-and-pull dynamic that determines short-term volatility and prevents rallies even when liquidity is rising.

- Liquidity and the Dollar help explain when Bitcoin accelerates or stalls, but they do not determine the long-term valuation path, which requires a separate framework to understand the level toward which price gravitates across multi-year horizons.

3. The Stock-To-Flow Model

- The Stock-to-Flow model was proposed in the past, but has since failed because it assumed scarcity alone drives price, treated halvings as deterministic step-changes, ignored demand and macro shocks, and created a misleading sense of precision that broke down in the 2021–2022 cycle when its predictions diverged sharply from reality.

4. The Power Law Model

- The Power Law model has become the preferred approach for institutional analysts, as it captures Bitcoin's long-term growth through time and adoption dynamics, producing a log-log valuation channel with identifiable upper peaks, a central fair-value trajectory, and lower-bound capitulation zones.

- Under the Power Law model, Bitcoin currently sits in a mid-cycle position, trading about 20 percent below its estimated fair value and well above its historical floor, indicating neither extreme euphoria nor deep capitulation compared with previous cycle tops and bottoms.

5. Energy-Based Valuation Models

- Energy-based valuation frames Bitcoin as digital energy storage secured by physical mining input.

- The Energy Value model currently estimates Bitcoin's fair price at roughly $145,000 to $167,800, well above market levels.

6. The Institutional Approach

- Bitcoin has become institutionalised since the ETF on spot BTC was approved in 2024. A further push to institutionalisation has come with the establishment of the Bitcoin Strategic Reserve by the US.

- Recent price weakness reflects a broader macro risk-off environment driven by doubts about Fed rate cuts, tech-sector selloffs, and ETF outflows, with Bitcoin now hovering near the average ETF holder cost basis and needing to regain the 95k–97k range to signal that market structure is stabilizing while the 90k psychological level remains critical for short-term sentiment.

1. Introduction

In our previous analysis, we demonstrated that Global M2 (global liquidity) acts as the fuel for Bitcoin's price cycles. The core thesis was straightforward: when central banks expand liquidity, asset prices tend to rise.

Liquidity cycles explain the timing of rallies: rising Global M2, driven by central bank quantitative easing and debt monetization, historically coincides with Bitcoin bull markets. Its price closely tracks expansions and contractions in global liquidity, especially during monetary easing (QE, low interest rates). Furthermore, periods of rising Global M2, such as post-2008 quantitative easing and the COVID-19 stimulus, coincided with major Bitcoin bull markets.

Conversely, tightening cycles or liquidity contractions often preceded corrections. A key empirical finding was the ten-week lag between changes in global M2 and Bitcoin's price, suggesting a delayed but strong correlation between liquidity shifts and Bitcoin performance. In conclusion, the piece positioned Bitcoin as a macro-sensitive store of value, whose long-term trajectory depends on central bank liquidity, debt dynamics, and investor sentiment — not just on crypto-specific factors.

New data suggests we must refine this view. Bitcoin does not move on a single clock, but rather interacts with two distinct macro forces. Firstly, Liquidity acts like "slow gravity." It provides the long-term lift for multi-month trends, often impacting price with a lag of approximately 84 days (about 12 weeks). Secondly, the strength of the Dollar acts as a "throttle" or brake. It exerts fast, immediate pressure on the price.

This creates a dynamic push-and-pull. Even if liquidity is entering the system (fuel), a rapidly strengthening Dollar (throttle) can choke off a rally, creating "headwinds" and choppy price action. This explains why Bitcoin doesn't always go "up only" the moment money printers turn on—the macro regime depends on *both* signals aligning.

But while M2 and the Dollar explain the timing and volatility of market moves, they do not explain the destination. They tell us when the car is speeding up or slowing down, but they don't tell us where the road leads.

To understand Bitcoin's long-term valuation anchor, the "Fair Value" that price gravitates toward over years rather than weeks, we must look beyond macro-liquidity to statistical valuation models. This brings us to the Power Law.

2. The Failed Prophecy: Why Stock-to-Flow Broke

For years, the dominant framework for understanding Bitcoin's value was the Stock-to-Flow (S2F) model. It offered a seductive and simple narrative: scarcity equals value (**Figure 1**).

The model relied almost exclusively on a supply-side thesis. It tracked Bitcoin's "halving" cycles—events every four years where the reward for mining and therefore the new supply of Bitcoin is cut in half. The S2F model assumed that because the asset was becoming scarcer mathematically, the price must increase exponentially in immediate, deterministic "steps."

However, S2F famously broke down during the 2021-2022 cycle. It predicted astronomical highs ($100k+) that never materialized. The failure highlighted the model's critical flaws:

- Supply Obsession: It assumed scarcity automatically creates value, ignoring demand.

- Rigidity: It treated Halvings as deterministic "price jumps" rather than gradual fundamental shifts.

- Macro Blindness**:** It failed to account for external shocks like global interest rate hikes.

Ethereum co-founder Vitalik Buterin has argued that S2F creates a misleading sense of precision, while many analysts point to deeper methodological flaws—such as overfitting, ignoring demand and liquidity factors, and treating halvings as abrupt valuation jumps that overlook market microstructure.

Figure 1: The Stock-to-Flow model

STF Model ● Price end of the day
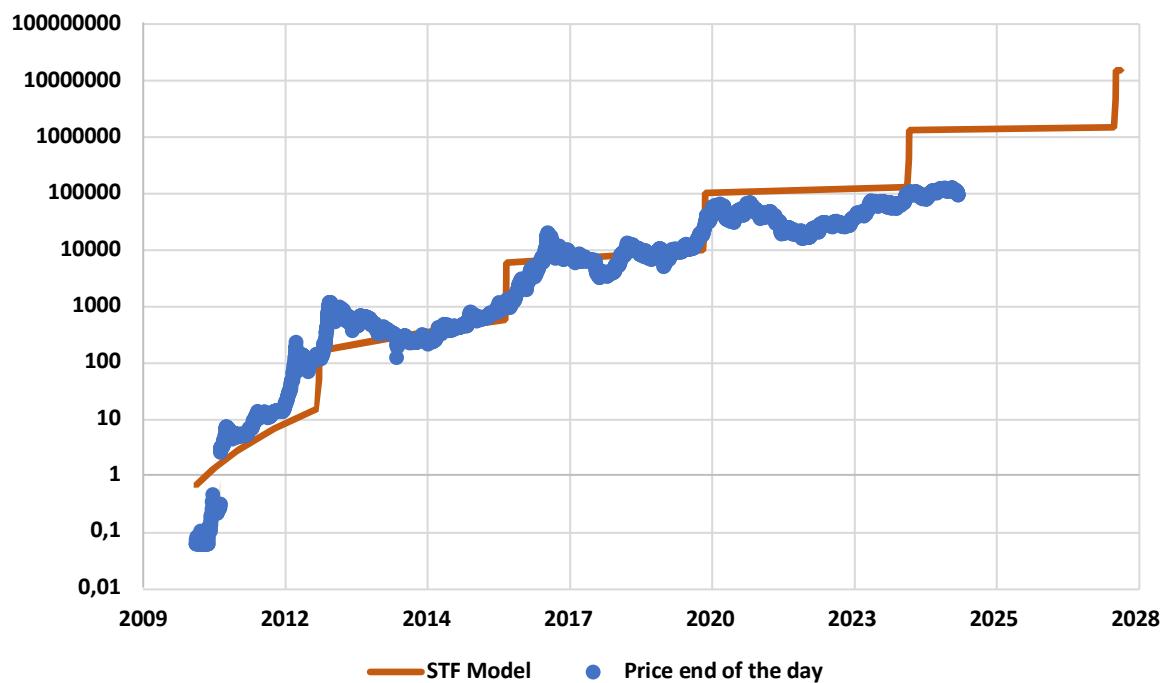
Source: Authors' calculations

3. The New Standard: The Power Law Model

In the wake of S2F's failure, the Power Law model has emerged as the preferred framework for institutional analysts. Unlike S2F, which relies on supply shocks, the Power Law relies on Time and Adoption. The logic is simple: Bitcoin's growth follows a "network effect." As the network ages and adoption spreads, the value increases, but the rate of that increase slows down over time. It implies that Bitcoin's growth follows a time-based compounding trajectory, gradually flattening as volatility declines with institutional maturity. This creates a predictable, decelerating curve rather than a vertical rocket ship.

Figure 2: The Power Law model

Price end of the day — Fair Value — Support Line — Resistance Line
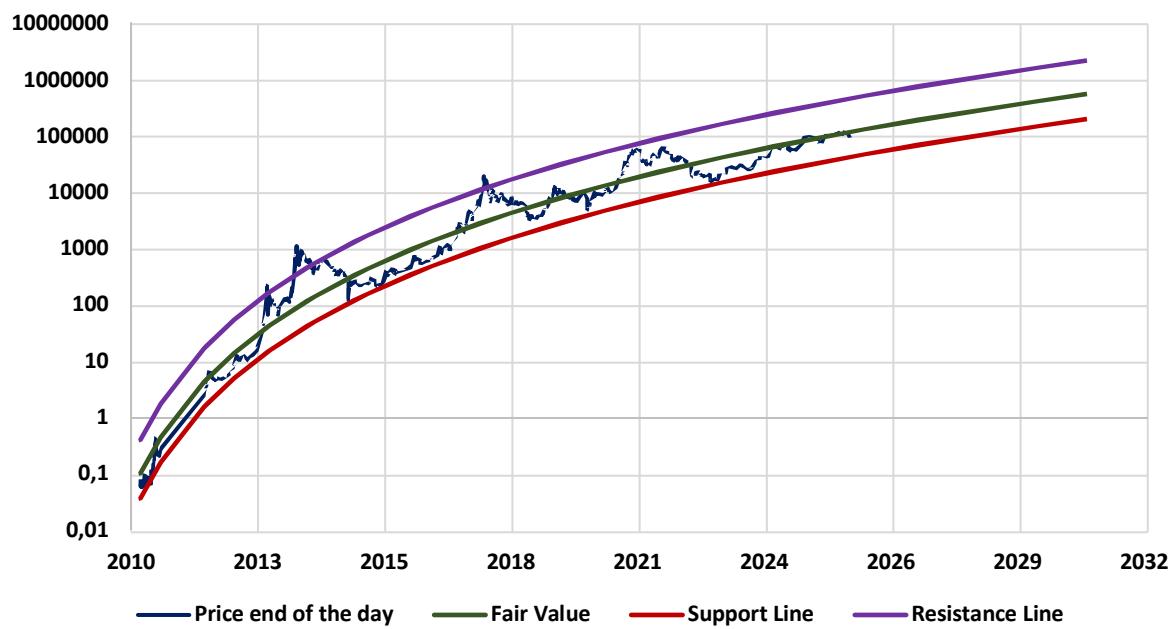
Source: Authors' calculations

The model uses a "log-log regression" (comparing the log of Price against the log of Time since 2009). This creates a broad channel:

- *The Middle Line (Fair Value)*: This represents the sustainable adoption curve. It is the "gravity" that price eventually returns to, regardless of temporary hype or panic.
- *The Upper Rail (Resistance)*: This marks euphoric peaks. Historically, this is where retail mania pushes the price too far, too fast (often fueled by the "Fuel" of Global M2 we discussed earlier).
- *The Lower Rail (Support)*: This marks capitulation bottoms. This is the floor where value investors step in, confident that the network's long-term utility remains intact despite short-term fear.

Unlike S2F, which broke when faced with real-world stress, the Power Law provides a flexible probabilistic framework. It acknowledges that price will violently oscillate—driven by the "Throttle" of the Dollar or the "Fuel" of liquidity—but asserts that these oscillations will remain confined within a predictable, rising growth channel.

Based on the model, Bitcoin is currently trading roughly 20% below its structural fair value and more than twice above the model's floor, a mid-zone placement that contrasts with prior cycle tops and bottoms when the price tagged the channel's resistance or support.

4. The Physics of Value: Bitcoin as Stored Energy

While the Power Law provides the *statistical* trajectory of Bitcoin, the fundamental driver of this growth is rooted in physics. This approach relies on our proprietary BTC = ENERGY equation developed by Brunello Rosa and Marco Lucchin in an earlier analysis, which posits that Bitcoin is not merely a financial asset, but a form of digital energy storage. Bitcoin derives scarcity from the real-world energy required to secure and produce each coin, creating a direct and unavoidable link between energy input and monetary value.

The value of BTC has always been associated to the energy cost to produce it. In his recent book, Benjamin Wallace writes: "When a Bitcoin exchange named New Liberty Standard launched in October 2009, it priced the single Bitcoin (BTC) at less than 1/10 of a penny, based on the cost of the electricity required to mine it.[1]"

Unlike fiat currencies, which can be generated by decree at near-zero cost, Bitcoin is created through Proof-of-Work. This mechanism acts as a bridge between the physical world (Joules of electricity) and the digital world (Value). Therefore, the intrinsic value of Bitcoin can be calculated based on the energy expenditure required to secure the network.

The Energy Value Metric

Current energy-based valuation models suggest Bitcoin is significantly undervalued. The Bitcoin Energy Value model, popularized by Charles Edwards of Capriole Investments, links fair value to three core inputs: miner energy input (Joules), supply growth, and a constant tied to fiat energy costs.

- *Valuation Gap*: With network hashrates hitting record highs, the model currently estimates Bitcoin's fair price between $145,000 and $167,800, representing a 31% to 45% premium over current levels.

- *Historical Precedent*: According to Edwards, Bitcoin is currently trading at a deeper discount to its energy value than it was at $10,000 in September 2020. Historically, such divergences are resolved when speculation-driven rallies eventually align with the rising energy floor. If miner energy input continues its upward trend, the model suggests strong long-term support for higher BTC prices.

Institutionalizing the Energy Asset

The characterization of Bitcoin as an energy derivative is gaining traction among institutional miners. In a recent editorial, Shane Neagle, editor-in-chief of "The Tokenist" wrote that Past intellectuals have argued for backing money with units of energy. Namely, in John Maynard Keynes' lectures of 1912 to 1913, which provided the

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[1] B. Wallace, "*The mysterious Mr Nakamoto: A 15-year quest to unmask the secret genius behind crypto*" Atlantic books, London 2025.

intellectual framework for a means of measuring money "in terms of units of electrical energy." This perspective reframes Bitcoin as a grid-stabilizing tool that monetizes stranded power, further justifying a valuation model based on energy utility rather than pure speculation.

Asymmetries in Production Costs

Recent empirical studies reinforce the link between price and energy, but with notable behavioral nuances. A study using NARDL and multiple-breakpoint regression on 2017–2023 data found a strong asymmetric relationship:

- *During Bull Markets*: When Bitcoin's price rises, miners' electricity use does not increase linearly. Miners tend to sell accumulated inventory to fund operations rather than immediately expanding energy-intensive infrastructure.

- *During Bear Markets*: When prices fall, energy consumption decreases rapidly as inefficient miners are forced offline.

This pattern contradicts the traditional Law of Supply and reflects strategic inventory management by miners. For investors, this implies that while energy sets the floor, the upside volatility is driven by supply shocks (halvings) and liquidity cycles, creating the specific "step-pattern" observed in our Stock-to-Flow and Power Law models.

5. Institutionalisation and Recent Developments in Bitcoin

After hitting a euphoric peak of ~$126,000 in October, Bitcoin corrected sharply, shedding nearly 30% of its value to test support levels. Crypto prices are falling largely due to a broader market pullback and growing doubts about further Fed rate cuts. Tech stocks have slumped amid warnings of an AI bubble and uncertainty over the payoff from massive data-center spending; Nvidia is down nearly 10% since late October and the Nasdaq about 4%. Because crypto and tech shares are treated as similar high-risk assets, they often drop together. Investors had hoped additional Fed rate cuts would lift prices, but sticky inflation has made policymakers more cautious. With fading expectations for cheaper borrowing, risk assets—including crypto—are under pressure.

Looking ahead, analysts say crypto's volatility makes forecasting impossible. However, clearly after the SEC approved the ETF on spot BTC in January 2024 and the US established the Bitcoin Strategic Reserve in March 2025, Bitcoin became institutionalised, and that has changed its price dynamics. Collapses in prices, while large, are not of the same scale as before as institutional adoption has provided a floor.

Bitcoin ETFs have brought more traditional investors into the market, yet prices remain unstable. Nearly $4.7 billion has exited crypto ETFs this month, though some funds tied to smaller coins like Solana and XRP have still attracted inflows.

Bitcoin is currently trading close to the average ETF holder cost basis (~$89,600) and well below the short-term holder cost basis (~$109,500), meaning most recent entrants are sitting on unrealized losses. This is consistent with a macro-driven risk-off environment rather than a structural breakdown. According to Glassnode, reclaiming the $95,000–$97,000 zone would signal the first signs of market healing, while maintaining support above the $90,000 psychological level is essential for stabilizing near-term sentiment.