Yuma

FUNDAMENTAL VALUE ANALYSIS FOR BITTENSOR SUBNET TOKENS

The purpose of this paper is to define Bittensor subnet tokens within the context of financial assets and establish a fundamental valuation framework to enhance their use in productive capital deployment.

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TL:DR

- Subnets generally function as replacements for operational expenses
- Forecasting equivalent internal OpEx spend can be used to forecast required miner emissions
- Comparing the required emissions forecast to the subnet token's supply curve can be used to determine the fundamental value of the token
- Subnet tokens are novel assets that replace a specific set of operational expenses with asset accumulation

GOALS AND CONTENT

Bittensor subnet tokens represent novel assets that provide investors with indirect financial exposure to value paid for specific operational expenses. By clearly defining this new asset class, we can also define how to value them and empower the market to use them productively.

This report presents a concise explanation of the role of subnet tokens as a means to incentivize productive work and a methodology to assess fundamental value of this new asset class. Notably, the framework outlined in this analysis is intended to describe subnets and subnet tokens in their default state. Subnet tokens may also offer additional utility or value depending on the circumstances within the subnet where they're used.

This report provides limited background information about Bittensor as relevant in the context of the analysis, but generally assumes the reader has foundational knowledge of the network, subnets, and emissions curves.

COMPANIES EXIST TO CREATE EQUITY VALUE

Companies exist to maximize the gap between what they earn and what they spend. Revenue minus expenses equals net income, and net income drives enterprise value.

This is why companies don't turn revenue into expenses unless they absolutely must - either for existing operations or to fuel growth. Every incremental cost must justify itself against the opportunity to preserve margin for the benefit of equity holders.

Rational companies will spend only what is required to achieve a given operational goal and retain the rest for shareholders or future investment.

PURPOSE OF SUBNETS

Subnets are focused, decentralized forums for specific operational functions. They generally target specialized work streams: train a model, run inference, validate outputs – or some combination thereof. Each subnet organizes participants around a task (or tasks) to generate an intelligence commodity and the Bittensor protocol produces subnet tokens as the native incentive reward for efforts related to that task.

Instead of hiring developers or buying hardware, companies can outsource functions to miners on the Bittensor network. Miners provide infrastructure and expertise, and for that they're compensated with subnet tokens generated by the network. There is a single subnet operator, but one or more companies, universities, or other parties may ultimately use the intelligence assets generated by miners in their various applications.

Importantly, a subnet doesn't directly create equity value - it creates operational capacity that can be used by companies to drive equity value. It's a distributed coordination layer with a built-in payment system, designed to replace specific internal cost centers with open competition.

SUBNET TOKENS AS ASSETS

In lieu of paying salaries or buying hardware, subnet token emissions coordinate and incentivize the same work from people all over the world.

Since subnet tokens' emissions schedules are defined[1] by the Bittensor protocol, the value delivered to miners in a given block, epoch, or day in the future can be determined based on subnet token price. This is critical, because it tells us exactly what the subnet token value will need to be to continue supporting the operational cost replacement.

[1] This can vary based on subnet liquidity dynamics, but within a limited, defined range that can be readily modeled.

VALUATION DRIVERS

Like most assets, subnet tokens derive value from two sources: fundamental buyers and speculative buyers.

FUNDAMENTAL VALUE

This is the natural incentive to transact for a purpose beyond direct financial gains from the transaction - in this case, paying for work. The economic driver for subnet tokens is simple: if the subnet output is required to support one or more companies' product or service, those companies are incentivized to ensure emissions are sufficient to compensate miners.

SPECULATIVE VALUE

This is the expectation of direct financial gain from holding or trading the asset. Speculation can amplify price movements, but it doesn't change the underlying economics. Without a fundamental economic need for the asset to exist, speculation is unlikely to sustain value.

NATURAL SELLERS

In order to supply infrastructure or services to subnets, miners incur costs including hardware, power, data, network, and time, among others. This creates natural subnet token sell pressure, as these parties monetize their earnings by trading them for their local currencies to pay expenses.[2]

CAPITAL ALLOCATION

Subnet operators are generally one of the primary parties with a fundamental economic interest in supporting the token price. When they buy tokens, the token price and the value of emissions to miners increase, further incentivizing the production of machine intelligence to improve the product or service subnet operators (and potentially others) are using to generate revenue.

Rational companies will buy the amount of tokens required to incentivize the operational goal at a given time - no more, no less – just as they would treat any other operational cost supporting their business. Similarly, they are incentivized to sell subnet tokens if emissions are above what is required to adequately compensate the miners to deliver the relevant service.[3] This allows them not only to maximize margins for equity holders, but also to preserve purchasing power in case additional token purchases to increase subnet incentives are needed in the future. This principle anchors the valuation logic.

Understanding this also helps define the critical role investors play for companies who use subnets to incentivize their distributed workforce. When investors drive up early subnet token value, subnet token emission value increases, enhancing incentives for people from all over the world to commit expertise and compute to the benefit of the companies using the subnet's outputs. This drives economic value for the company by enhancing product development, increasing the likelihood the company will generate enough revenue (and/or financing) to buy tokens on the open market in the future. By participating in emissions and future principal growth of the subnet token if companies, users, or other investors buy more subnet tokens over time, there is potential for investors to realize an attractive total return. With the model proposed in this paper, investors can forecast future token value and resulting returns for a given entry price.

[2] In the examples later in this paper, we assume miners sell 100% of their tokens earnings for simplicity of analysis – this is parameterized in the model and can be adjusted for each subnet.

[3] It should be noted that subnet operators selling their subnets' tokens can impact investor perception, which should be weighed when making such a decision. This paper focuses exclusively on assessing fundamental value, on top of which market dynamics would need to be considered – as would be the case with any other asset.

VALUATION METHODOLOGY

Valuing subnet tokens starts with a simple premise: they exist to replace specific operational expenses. By using a typical corporate expense forecast, combined with Bittensor's defined supply curves, we can determine the fundamental value of subnet tokens at present date and in the future.

The process is outlined below, along with an example implementation for a hypothetical subnet. For the sake of simplicity, the example assumes a single company is leveraging the outputs of the subnet.

FORECAST OPERATIONAL NEEDS

First, estimate the cost of the work the subnet is replacing (e.g. compute, infrastructure, expertise). This can be done through one or more established methods, including bottoms-up analysis, comparable company analysis, and management forecasts.

> ***Example:*** *Company X would need to spend $2,000,000 annualized on an engineering team to train their model, increasing by 50% per year for the next five years.*

TRANSLATE THE OPERATIONAL COST INTO REQUIRED EMISSIONS VALUE

To calculate the token price that produces emissions value sufficient to replace the internal operational cost, we use Bittensor's pre-defined subnet token issuance schedule.

> ***Example:*** *Assume for this example the required compensation to miners is equivalent to internal spend at Company X[4]. With this info, we can project the subnet token price required to generate the emissions necessary to compensate miners, both today and in the future.*

Fundamental Token Value = Daily OpEx Replacement / Daily Miner Emissions

- Annual OpEx Replacement = $2,000,000
- Daily OpEx Replacement = $2,000,000 ÷ 365 = $5,479
- Daily Miner Emissions[5] = 7,200 * 0.41 = 2,952 subnet tokens
- Fundamental Token Value = $5,479 / 2,952 = $1.86 per token

[4] It is conceivable that companies leveraging subnets could be more efficient than the equivalent internalized OpEx. The model used for this paper has an efficiency parameter, but for simplicity of explanation in this example we assume equivalent internal and miner compensation costs.

[5] For the sake of simplicity, this example uses zero miner burn. In the case of miner burn, the same core principles of this analysis apply as it relates to OpEx replacement value, for which the model's supply parameters can be adjusted

DEFINE REQUIRED TOKEN PRICE BASED ON SUPPLY CURVE

Bittensor subnets have a fixed 21M token supply and a predefined emission program. By applying this schedule to the emissions values over time required to support the OpEx replacement facilitated by miners, we can forecast the required price for the subnet token at any point in the future.

> ***Example:*** *Continuing the Company X example, if we want to project the required payouts to miners and validators in the future, as well as the required token price to facilitate those emissions, we can do as follows (assumes daily compounding expense rate to 50% annualized)*

Daily Growth Rate: $g_{daily} = (1 + g_{annual})^{1/365} - 1$

For 50% annual growth: $g_{daily} = (1.50)^{1/365} - 1 = 0.00111$

Daily Compounded OpEx: $OpEx_t = OpEx_0 * (1 + g_{daily})^t$

Where:

- $OpEx_0$ = initial daily OpEx
- $_t$ = number of days since start

Company X Example: *calculate the required token price in one year based on the OpEx replacement cost forecast*

- Initial daily OpEx = $5,479
- Daily Growth = 0.00111 or 0.111%
- After 365 days:

  $OpEx_{365} = \$5,479 * (1.00111)^{365} = \$8,210$

  $\text{Required Token Price}_{365} = \$8,210 / 2,952 = \$2.78$

Using this method, we can create a forward price curve,[6] from which we can derive a projected price of $18.97 after four years.

[6] The vertical increases reflect required token value change at future halving events

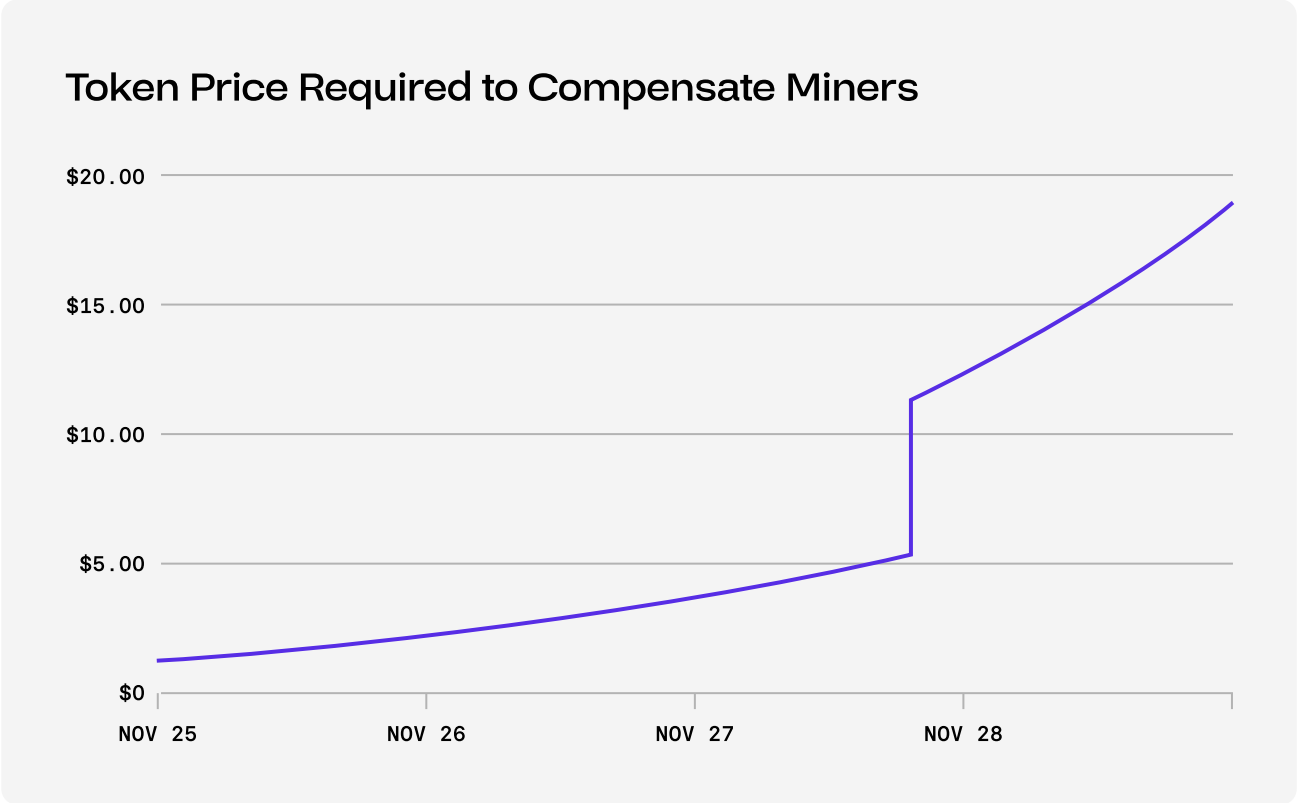

Figure 1 - Forward price curve based on fundamental value, including impact of subnet halving in 2028

PRESENT VALUE OF FUTURE EMISSIONS

Once we have the projected required token price, we can compare that to the subnets emission schedule and calculate the required value of future emissions and their present value.

Example: Using the Company X required token price defined above and the standard subnet emissions schedule, we can apply a standard discounted cash flow model to determine the present value of future yield. Assuming a four-year target holding period:

- **Initial Annual OpEx:** $2,000,000
- **Daily Compounding Growth:** 50% annually
- **Subnet Halving:** 2028-08-26 (emissions drop from 7,200 to 3,600 tokens/day)
- **Discount Rate:** 30%
- **Miners Emissions:** 2,952 at T_0

Applying a daily discounted cash flow (DCF) model:

$$PV = \sum_{t=0}^{T} \frac{C_t}{(1+r)^{\frac{t}{365}}}$$

Where:

- PV = Present Value of future emissions
- C_t = Required emissions value on day t
- r = Annual discount rate (30%)
- t = Day index (from 0 to 1461 for 4 years)
- T = Total number of days in the holding period (1461 days)

Total Subnet Emissions over Four Years: $46.2M
Total Present Value of Subnet Emissions = $24.5M

With this, we can estimate the discounted value of future emissions an investor would earn over the 4-year period beginning 2025-11-04 if the subnet token trades to its fundamental value.

For the sake of the example, the investor stakes 1,000 subnet tokens to a validator on the first day of the subnet at the fundamental value price of $1.86 (as calculated earlier).

First calculate the total emissions to the investor (staking rewards) for each day:
*(Investor Tokens$_t$ / Total Subnet Tokens Staked$_t$) * Token Emissions to Stakers$_t$ * Token Price$_t$*

When summing those over four years, we get a total of $20,961. Discounting those at the same 30% discount rate, we get a cumulative present value of $7,334.

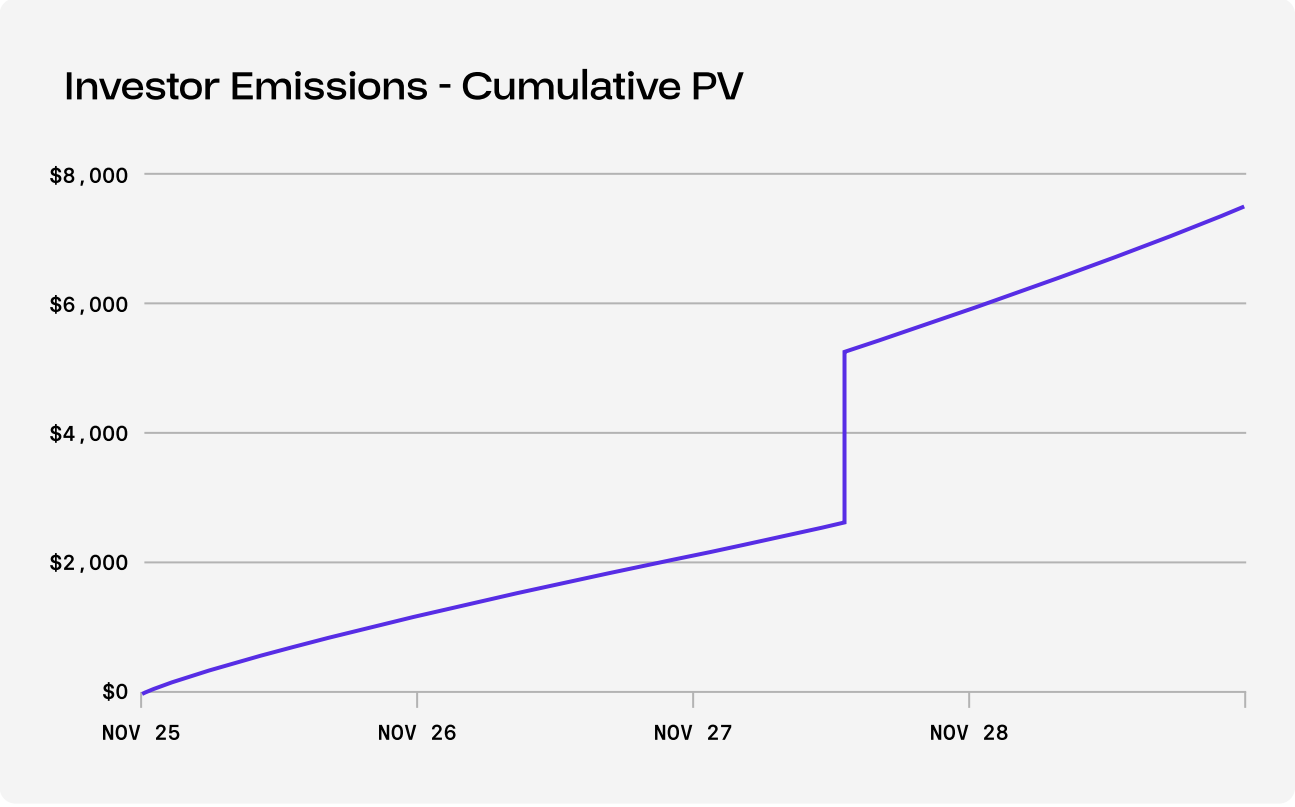

Figure 2 - Cumulative present value of emissions to the investor assuming the investor holds the entirety of emissions received for the duration of the four-year period

CALCULATING TOTAL RETURN

To calculate the return of an investment made today and held for a given time horizon, simply add the projected token price at that date and the value of the emissions from T0 to Tn, then subtract the original purchase price.

> ***Example:*** *Continuing the Company X example, we can add the 4-year projection for fundamental token value ($18.79) and the projected emissions to an investor holding[7] 1,000 subnet tokens at T_0 ($20,961).*

Principal Value in Four Years: *1,000 * $18.79 = $18,794*
Total Return: *$18,790 + $20,961 = $39,751*

For the sake of this example, assume a $5 token price at original investment ($5,000 initial investment for 1,000 tokens). With this, we can calculate investor return over the four-year holding period[8].

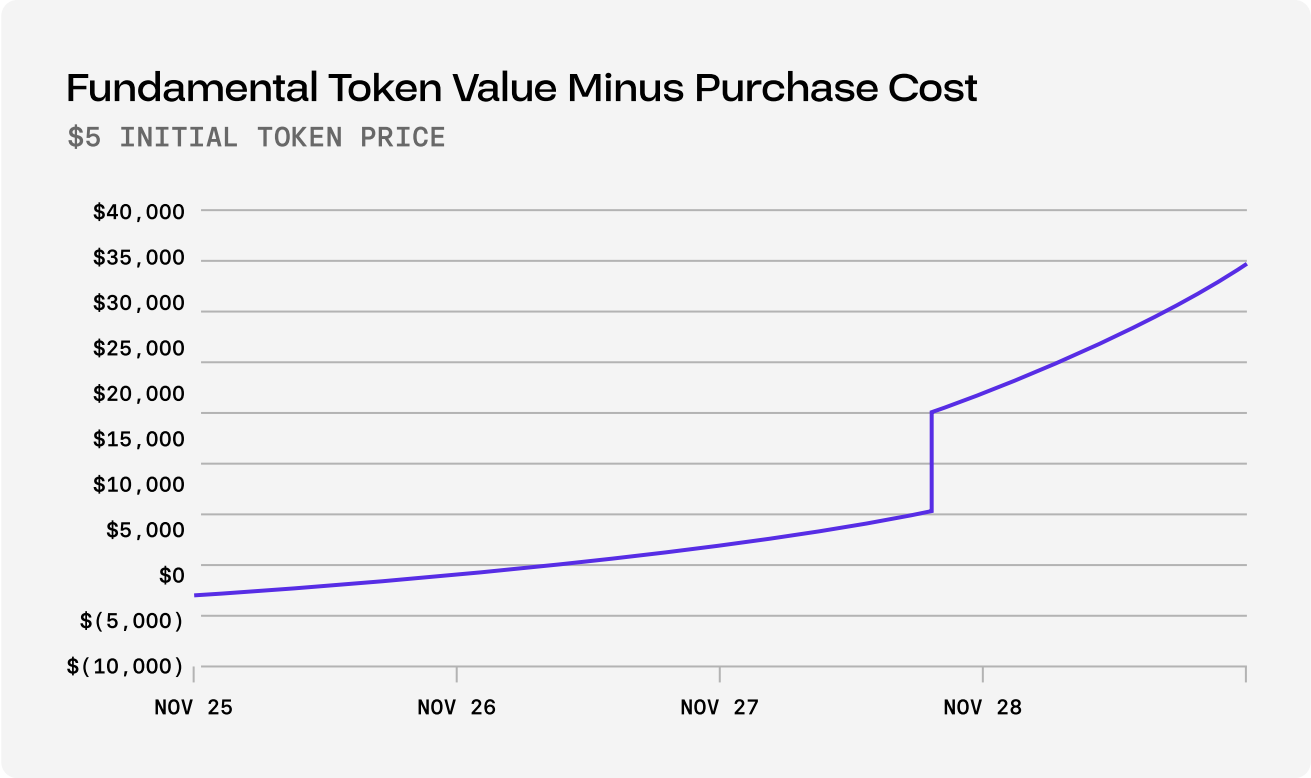

Figure 3 - Assumes a $10/token initial purchase price

[7] Example assumes the investor holds all of their token emissions – a variable that could be modeled differently based on investor intent

[8] Return profile assumes 1) the subnet survives long enough to realize the return, and 2) regression to the fundamental value, which could be impacted by market dynamics in either direction

If, for example, the original purchase price was $10 (as shown in the chart below), the return profile would be quite different. It is for this reason that a fundamental value model is critical for investors to confidently allocate capital to this nascent asset.

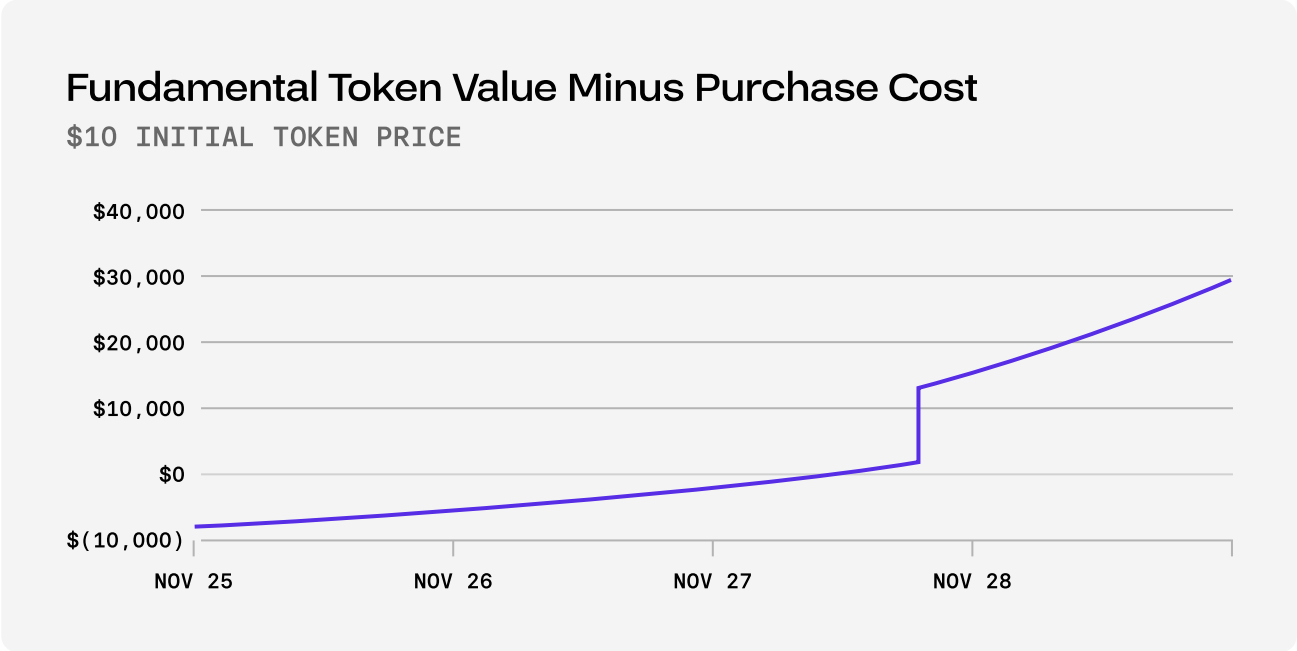

Figure 4 - Assumes a $10/token initial purchase price

If the original purchase price was $2, the return profile would naturally be more favorable:

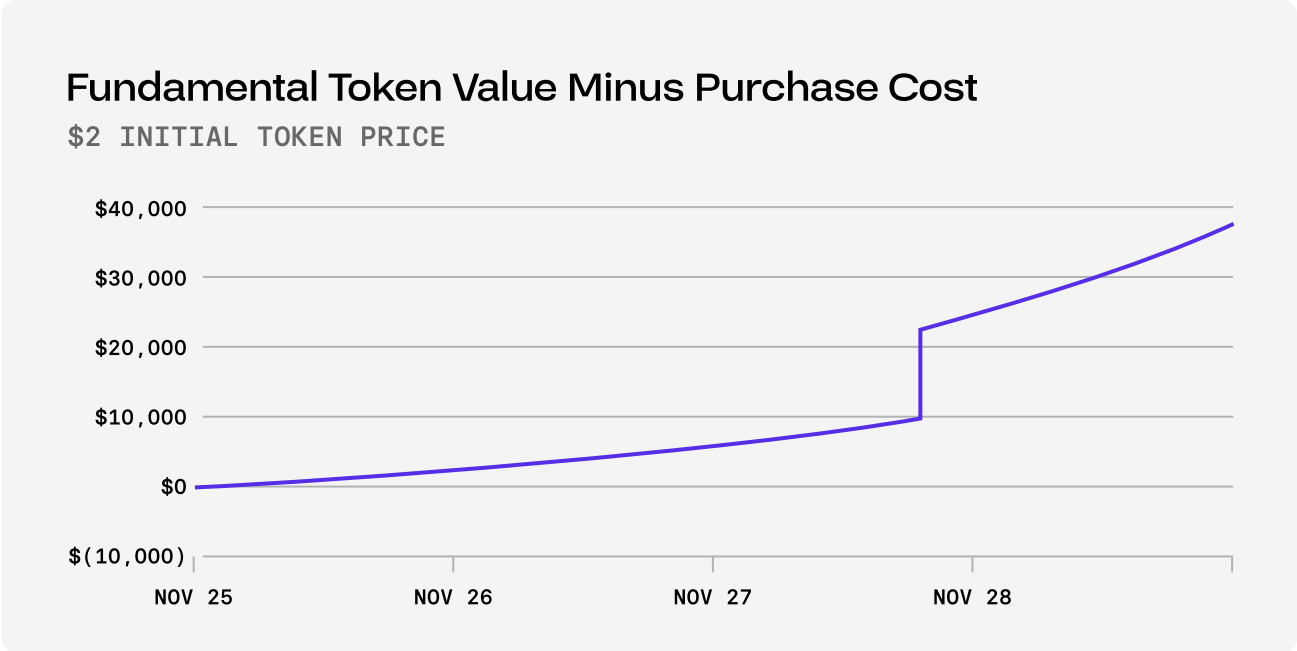

Figure 5 - Assumes a $2/token initial purchase price

TRANSITIONING FROM SPECULATIVE TO FUNDAMENTAL VALUE

Revenue generated by one or more companies making productive use of the subnet outputs can be expected to support an increasing proportion of the subnet token purchases required to facilitate sufficient emissions over time. This creates a sustainable subnet, and sustainable value for the subnet token.

Example: *Continuing the Company X example, if we assume the same forward cost curve described earlier in this paper, and $1,000,000 annualized company revenue at T_0,[9] growing at 75% per year, we can see that investor purchases of the token are required to support $1,000,000 of emissions initially, with the company (or companies) benefiting from the subnet's outputs purchasing an increasing amount over time.*

Perhaps most importantly, we assume companies act rationally in the context of their expenses and will not purchase any more tokens than are required to facilitate the necessary emissions value, instead posting the remainder to retained earnings. This is what drives the fundamental value of the subnet token.

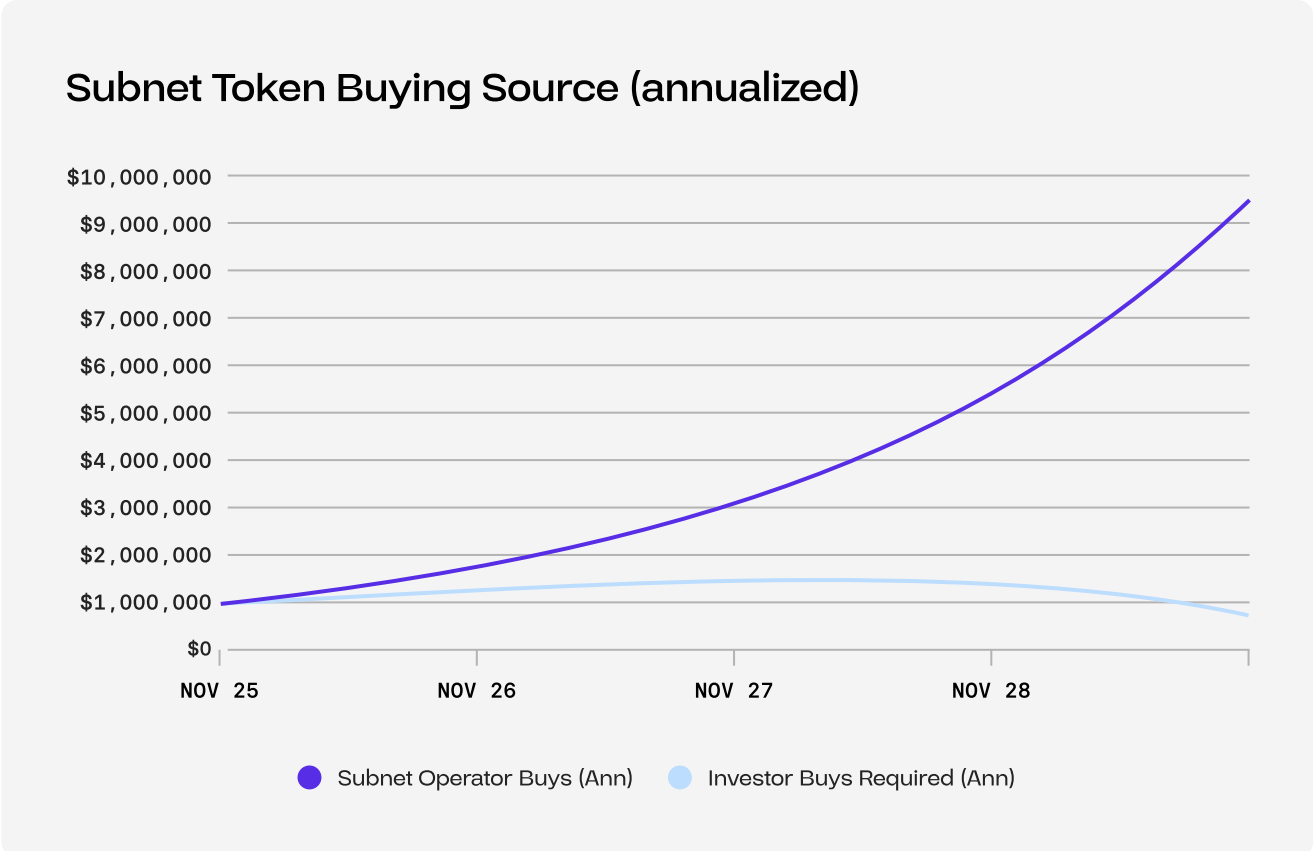

Figure 5 - As revenue grows, companies are able to support a greater portion of the token purchases to maintain the price necessary to compensate miners. In practicality, this may be supplemented by ongoing purchases from investors.

[9] For simplicity in this example, we assume 100% of the company's revenue goes to subnet token purchases until the required emissions rate is achieved.

LATE-STAGE TOKEN INVESTING

Investors are effectively participating in value flows between suppliers (miners) and a company (or companies[10]). In the early stages of subnets, token holders drive value in the asset used to compensate miners. In the later stages of a subnet, investors participate in the subnet token value driven by a broader range of market forces, including token purchases by companies who rely on the intelligence outputs to support their products.

With mature companies that have sufficient revenue to fund all required subnet token purchases and choose to tap subnets for efficiency, the investment profile is quite different. The reliability of purchases is far greater, reducing the risk (and discount rate) applied within this model.

THE CRITICALITY OF VALIDATORS

Though mentioned little so far in this analysis, the criticality of validators in this process cannot be overstated. In addition to providing a technical utility to the market by running software and/or hardware to assess the quality of miner outputs – often at high expense – validators provide the conduit for investor capital to drive token value.

Investors benefit from the effort of validators by delegating their stake to a person or entity performing the validation function, from which investors share in staking returns. This is why, despite being a purely technical and ministerial role with no formal relationship or obligation to investors, validator performance and reliability are key considerations for investors and, ultimately, provide the foundation of the capital flow outlined in this paper.

[10] It should be noted that the outputs from Bittensor miners may be used by multiple companies under certain conditions, in which case the number of parties with an interest in maintaining the appropriate incentive price increases. However, this does not impact the underlying operational expense analysis, regardless of how many parties have a shared interest in a subnet's continuation.

ADDITIONAL THOUGHTS

By identifying what subnets actually are, companies leveraging subnets can consider how best to use them. Subnets can be thought of as real-time vendor agreements for outsourced functions. Companies are large, complex organizations with many functions, of which subnet interactions may be just a subset. If we equate subnets to companies, rather than a specific outsourced function, it not only overcomplicates the operator-miner relationship, but will unduly discourage larger, existing companies from leveraging Bittensor.

It should also be noted that subnet tokens are clearly not equities. There is no inherent obligation for companies to purchase a subnet's tokens, many parties can benefit from a subnets outputs, and there is no guarantee that the need for the service the subnets provide will continue indefinitely, even if the company is successful. The companies consuming a subnet's outputs may expand their product offering, or alter the inputs that go into making the same products, which could expand or diminish their need for the subnet (and subnet tokens) altogether.

Interestingly, the subnet model also turns expenses into investments. Companies that would have historically had developer salaries, for example, can now purchase tokens as a way to indirectly compensate a fleet of global engineers. While this does have a cost, the company still retains an asset (the subnet tokens) for that cost, whereas it would have historically been money that was gone forever.

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