Bittensor Subnet Valuation Framework

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1 Introduction

This memorandum develops an analytical framework for valuing Bittensor subnets. The treatment combines

1. hardware operating expenditure,
2. user-generated cash-flows,
3. peer financing benchmarks, and
4. the token-supply mechanics dictated by Dynamic TAO (dTAO).

All monetary figures are stated in United States dollars (USD) unless noted; all present-value calculations employ a **20 percent** discount rate (denoted $d = 0.20$).

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2 Motivation

Under Dynamic TAO every subnet's token supply, reward schedule and burn mechanics differ materially from conventional Web 3 projects. Early-epoch inflation, hardware intensity and the interplay between Alpha prices and TAO halvings complicate standard venture valuation heuristics. A transparent framework is therefore required to:

- benchmark the economic floor for securing a subnet;
- quantify the upside from prospective user adoption;
- reconcile token-supply growth with comparable market valuations; and
- provide investors a defensible discount or premium when committing off-chain capital.

The sections that follow operationalise these objectives via four complementary lenses.

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3 Methodological Pillars

Pillar	Captured quantity	Output symbol
Cost-of-Participation	Net-present cost of running the required mining + validation set	NPC_α
Net-Present Value of Users	Discounted profit stream from end users	$NPVU_\alpha$
Comparable-Deals Benchmark	Median post-money valuations from 313 decentralised-AI financings	V_{market}

Pillar	Captured quantity	Output symbol
Inflation Anchoring	Circulating Alpha at investor horizon T	$S_{\max}(T),\ S_{\min}(T)$

Here $S_{\max}(T)$ and $S_{\min}(T)$ denote, respectively, the cumulative Alpha under maximal and minimal issuance (derived in Section 6).

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4 Cost-of-Participation (CoP)

4.1 Per-node operating expenditure

(The table below assumes a power price of 0.12 USD kWh^{-1} and PUE = 1.2.)

Hardware profile	Cap-ex \$ day^{-1} [1]	Power \$ day^{-1} [2]	Total \$ day^{-1}
CPU only	2.00	1.20	**3.20**
8 × RTX 4090	25.00	18.00	**43.00**
8 × A100	64.00	22.00	**86.00**
8 × H200	90.00	25.00	**115.00**

[1] Five-year straight-line depreciation, 12 % cost of capital.
[2] Operating electricity cost.

4.2 Subnet-level expenditure and present value

Let

- N = miner-node count, N_v = validator-node count;
- M and V = per-node daily costs from Table 4.1;
- $K \geq 1$ = labour-complexity multiplier (baseline 1.0);
- P_α = spot price of the subnet's Alpha token.

Daily burn (USD)

$$C = 365.25K(NM + N_v V).$$

Present value (USD)

$$\mathrm{NPC}_{\mathrm{USD}} = \frac{C}{d}.$$

Converted to Alpha

$$\boxed{\mathrm{NPC}_\alpha = \frac{C}{d\,P_\alpha}}.$$

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5 Net-Present Value of User Cash-Flows (NPVU)

Let

- U = steady-state active user count,
- ARPU = average revenue per user per year (USD).

Perpetuity (USD)

$$\mathrm{NPVU}_{\mathrm{USD}} = \frac{U\,\mathrm{ARPU}}{d}.$$

Finite horizon T years

$$\mathrm{NPVU}_{T,\mathrm{USD}} = U\,\mathrm{ARPU}\,\frac{1-(1+d)^{-T}}{d}.$$

After division by P_α the result is $NPVU_\alpha$.

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6 Comparable-Deals Benchmark

Stage	Median valuation (USD M)	Observations	IQR (25–75 %)
Pre-Seed	20	57	10 – 30
Seed	26.8	156	15 – 50
Strategic	50	34	26 – 75
Private	44	64	21 – 72
Series A	125	2	113 – 138

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7 Token-Supply Dynamics

7.1 Maximum per-block issuance

Let

- $\Delta\tau$ = TAO minted per base-chain block,
- $\sum_j p_j$ = cross-subnet price sum (empirically 1–2, baseline 1.5),
- $\overline{\Delta\alpha_i}$ = subnet-specific hard cap on Alpha issuance.

$$\delta_1 = \frac{\Delta\tau}{\sum_j p_j}, \quad \delta_2 = \overline{\Delta\alpha_i}, \quad \delta = \min(\delta_1, \delta_2).$$

Maximum issuance

$$\boxed{\Delta\alpha_{\max} = 2\,\delta}.$$

7.2 Minimum net issuance

Define

- β_m = fraction of miners' reward (0.41 δ) immediately burned,
- B_r, B_x = registration and external burns (Alpha block^{-1}).

$$\boxed{\Delta\alpha_{\min} = 2\,\delta - \left[\beta_m\,(0.41)\,\delta + B_r + B_x\right]}.$$

7.3 Cumulative supply up to horizon T

Let t_0 be subnet genesis; integrate over time t:

$$S_{\max}(T) = \int_{t_0}^{T} \Delta\alpha_{\max}(t)\,\mathrm{d}t, \qquad S_{\min}(T) = \int_{t_0}^{T} \Delta\alpha_{\min}(t)\,\mathrm{d}t.$$

Numerical evaluation is implemented in the companion calculator.

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8 Estimating Future Circulating Supply

To estimate the circulating Alpha at a future date T the investor specifies:

Required input	Symbol	Comment
Existing circulating supply (today)	S_0	as on-chain
Average sum-of-prices $\langle \sum p \rangle$	Σ	choose within 1 – 2
Miner-burn fraction	β_m	0 – 1
Registration burn / block	B_r	Alpha block⁻¹
External burn / block	B_x	Alpha block⁻¹
Next TAO-halving date	T_h	calendar date

8.1 Block-level issuance across a halving boundary

Let

- $D = T - t_{\text{now}}$ = days until horizon,
- D_h = days from *now* to the TAO-halving date T_h (clip to 0 if $T \le T_h$),
- 7 200 blocks per day.

Split the horizon into **Segment 1** (pre-halving, $D_1 = \min(D, D_h)$) and **Segment 2** (post-halving, $D_2 = D - D_1$).

For each segment $k \in \{1, 2\}$ set

$$\Delta\tau^{(k)} = \begin{cases} \Delta\tau_{\text{current}}, & k = 1 \\ \frac{1}{2}\,\Delta\tau_{\text{current}}, & k = 2 \end{cases}$$

Compute the per-block limit

$$\delta^{(k)} = \min\!\left(\tfrac{\Delta\tau^{(k)}}{\Sigma}, \overline{\Delta\alpha_i}\right).$$

8.2 Net Alpha minted in each segment

Net per block

$$\Delta\alpha_{\text{net}}^{(k)} = 2\,\delta^{(k)} - \left[\beta_m\,(0.41)\,\delta^{(k)} + B_r + B_x\right].$$

Total minted

$$M^{(k)} = 7\,200 \times D_k \times \Delta\alpha_{\text{net}}^{(k)}.$$

8.3 Projected circulating supply at T

$$\boxed{S(T) = S_0 + M^{(1)} + M^{(2)}}.$$

> **Worked example**
> *Inputs:* $S_0 = 2.5$ M Alpha, $\Sigma = 1.5$, $\beta_m = 0.25$, $B_r = 0.02$, $B_x = 0$ Alpha block⁻¹, current $\Delta\tau = 1$, TAO halving in 180 days, horizon T in 540 days.
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> Segment-level calculations yield $M^{(1)} \approx 0.47$ M, $M^{(2)} \approx 0.18$ M, hence $S(T) \approx 3.15$ M Alpha.

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9 Conclusion

The framework now enables a practitioner to project circulating supply directly from observable burns, price aggregates and halving timing, then embed that projection into cost-, demand- and market-based valuation bounds.
All variables are defined locally at first use to minimise cross-reference latency; numerical examples are readily reproduced with the associated calculator.