L29: Token Economics Fundamentals

Module D: Tokenomics

Blockchain & Cryptocurrency

December 2025

Learning Objectives

- Describe different token types (utility, governance, security) and their purposes
- Analyze value accrual mechanisms in token economies
- Evaluate token supply models and their implications
- Apply tokenomics principles to real-world projects

Building on L28: Lab: NFT Evaluation

The Token Economy Challenge

[COMIC: Supply and demand basics]

A visual narrative showing the fundamental tension in token economics

Visual framing: The balance between token creation and value preservation

What This Illustrates

- Token supply must match demand to maintain value
- Emission schedules affect long-term price dynamics
- Scarcity vs. accessibility trade-offs

The Question

How do we design token economies that don't collapse under their own weight?

The Problem: How do we create sustainable token economies?

The Challenge
Designing a token that aligns incentives across users, developers, investors, and validators without collapsing into a speculative bubble or death spiral. Most token economies fail because they prioritize short-term hype over long-term sustainability.

Why It Matters

- Over 95% of ICO-era tokens failed due to poor economic design
- Terra/Luna collapsed ($40B) from flawed algorithmic stablecoin tokenomics
- Inflationary token spirals destroy user trust and protocol viability

What We Need

- Economic alignment of actors
- Sound monetary policy (supply schedules, emission rates)
- Real utility beyond speculation (value capture mechanisms)

The Cryptoeconomics Question
How do we design incentives so participants act in the protocol's best interest while pursuing their own gains?

Today's lesson: How Token Economics addresses this challenge

What is Tokenomics?

Definition: The study of the economic systems governing the creation, distribution, and management of tokens in blockchain ecosystems.

Key Components:

- Token design and purpose
- Supply and distribution mechanics
- Incentive structures
- Value capture mechanisms
- Governance and utility

Why It Matters: Tokenomics determines the long-term sustainability and success of crypto projects.

Problem: Why do most tokens fail economically? — Tokenomics provides frameworks to design sustainable supply, demand, and incentive structures

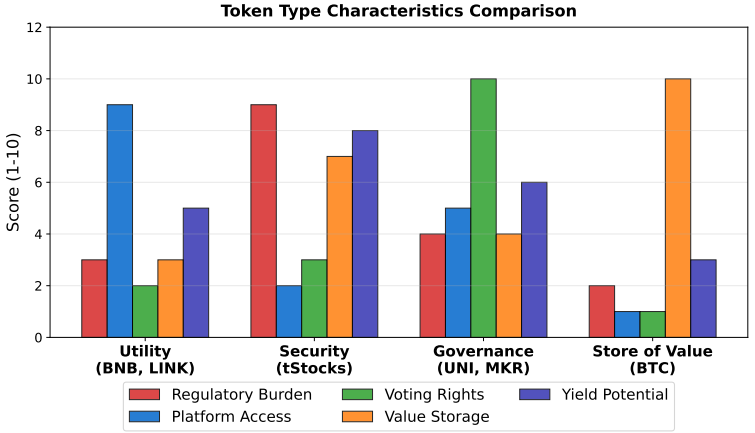
Continued

What Are the Main Types of Tokens?

1. **Utility Tokens**
   - Access to platform services
   - Payment for network fees
   - Examples: BNB, LINK, FIL
2. **Security Tokens**
   - Represent ownership/dividends
   - Subject to securities laws
   - Examples: tokenized stocks, bonds
3. **Governance Tokens**
   - Voting rights on protocol changes
   - DAO participation
   - Examples: UNI, AAVE, MKR
4. **Store of Value Tokens**
   - Digital gold analogy
   - Limited supply
   - Example: BTC

Compare the approaches shown above

Token Types Characteristics



Security tokens have highest regulatory burden; governance tokens offer strongest voting rights

How Do Utility Tokens Work?

Purpose: Access to products/services
Characteristics:

- Not designed as investments
- Required for platform interaction
- Value linked to usage
- May offer fee discounts

Example: Binance Coin (BNB)

- Trading fee discounts on exchange
- Gas fees on BNB Chain
- Token sale participation (Launchpad)
- Quarterly burns based on volume

Compare the approaches shown above

What Makes a Token a Security?

Definition: Investment contracts subject to securities regulations

Howey Test Criteria:

1. Investment of money
2. In a common enterprise
3. Expectation of profits
4. From efforts of others

Implications:

- Must comply with SEC (US)
- Require registration/exemption
- Investor protections apply
- Often limited to accredited investors

Examples: Tokenized stocks, bonds, real estate

Compare the approaches shown above

How Do Governance Tokens Create Alignment?

Purpose: Decentralized decision-making
Voting Rights:

- Protocol parameter changes
- Treasury allocation
- Fee structure modifications
- Smart contract upgrades

Example: Uniswap (UNI)

- Protocol fee governance
- Treasury management ($B+ assets)
- Grant program decisions
- 1 UNI = 1 vote (delegatable)

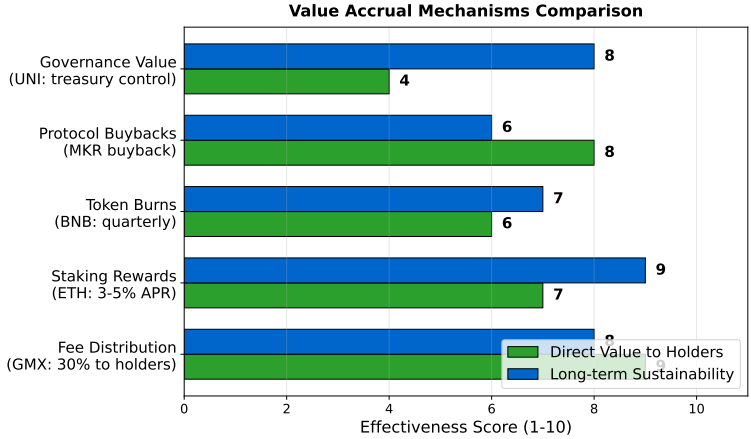
Problem: How do we align token holder interests with protocol success? — Governance tokens create economic skin-in-the-game by tying voting power to token ownership

How Do Tokens Capture Value from Protocol Success?

1. **Fee Distribution**
   - Protocol fees shared with token holders
   - Example: GMX distributes 30% of trading fees
2. **Staking Rewards**
   - Lock tokens to earn yield
   - Example: Ethereum validators earn ETH rewards
3. **Token Burns**
   - Reduce circulating supply
   - Example: BNB quarterly burns, ETH EIP-1559

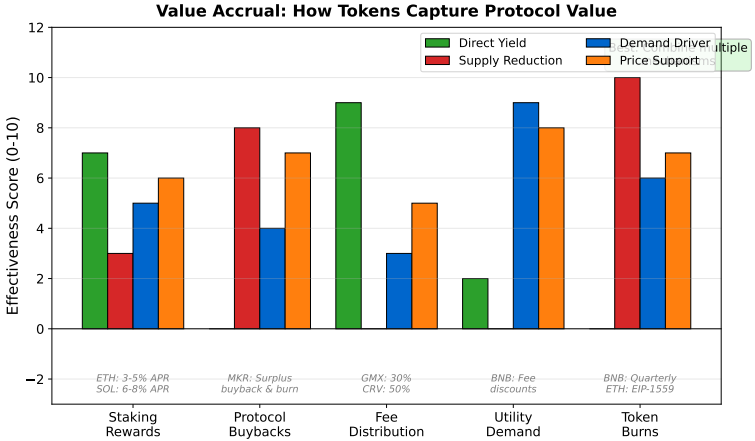
Key point: Fee Distribution

Value Accrual Mechanisms Comparison



Fee distribution provides direct value; staking rewards offer best sustainability

Value Accrual: Capturing Protocol Value



Best tokenomics combine multiple mechanisms: staking for yield, burns for supply reduction, utility for organic demand

Why Choose Fixed Supply Models?

Characteristics:

- Predetermined max supply
- No new tokens after cap
- Deflationary if burned

Advantages:

- Scarcity drives value
- Predictable monetary policy
- Inflation protection

Bitcoin Example:

- Max: 21 million BTC
- Current: 19.5M (2024)
- Halving every 4 years
- Final BTC: year 2140

Compare the approaches shown above

What's the Difference Between Inflationary and Deflationary Models?

Inflationary:

- New tokens continuously created
- Rate may be fixed or decreasing
- Incentivizes participation

Deflationary:

- Supply decreases over time
- Tokens removed via burns
- Creates scarcity pressure

Compare the approaches shown above

BNB Burn Mechanism:

- Auto-Burn: based on gas fees
- Target: 100M (from 200M)
- Current: 144M (Dec 2024)

Problem Check-In: Token Economics

Recall Our Problem

How do we create sustainable token economies?

What We've Learned So Far

- Token types (utility, governance, security) serve different economic purposes and face different regulations
- Value accrual mechanisms (fee distribution, staking, burns) connect token price to protocol success
- Understanding token purpose and value capture is the foundation of sustainable token design

Still to Address

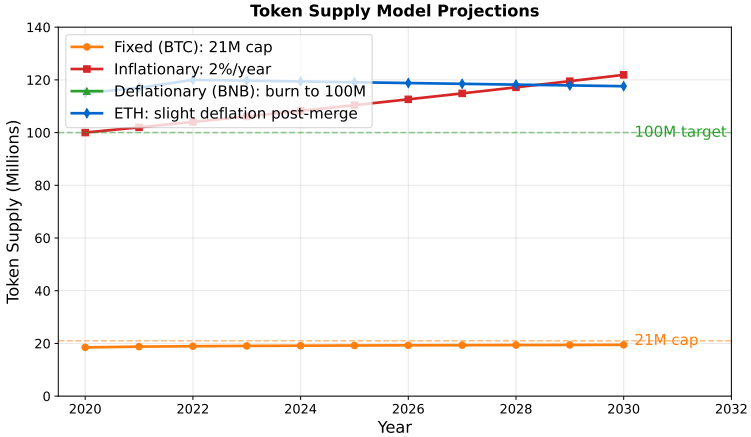
- Supply models, emission schedules, and velocity control mechanisms
- How do we balance token creation incentives with long-term scarcity?

Think About

- Based on what you've seen, how would *you* solve this problem?
- What trade-offs do you expect?

Pause and reflect: How does what we've learned so far address "How do we create sustainable token..."?

Supply Model Projections



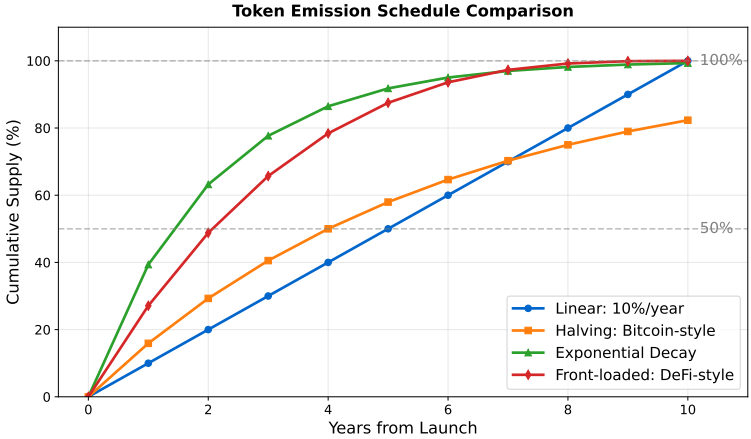
BTC approaches 21M cap; BNB burns toward 100M; ETH slightly deflationary post-merge — Supply schedules create predictable scarcity, a key sustainability factor

How Do Tokens Enter Circulation Over Time?

1. **Linear Emission**
   - Constant rate of new tokens
   - Predictable but perpetual inflation
2. **Decreasing Emission**
   - Halving events (Bitcoin model)
   - Gradually reducing inflation
3. **Exponential Decay**
   - Rapid initial distribution
   - Asymptotically approaches max supply
4. **Algorithmic Adjustment**
   - Based on network metrics
   - Example: Ethereum's variable issuance

Key point: 1. Linear Emission

Emission Schedule Comparison



DeFi protocols often use front-loaded emission; Bitcoin uses halving model

Why Does High Velocity Suppress Token Price?

High token velocity (frequent buying/selling) can suppress token price.

Equation of Exchange:

$$MV = PQ$$

where:

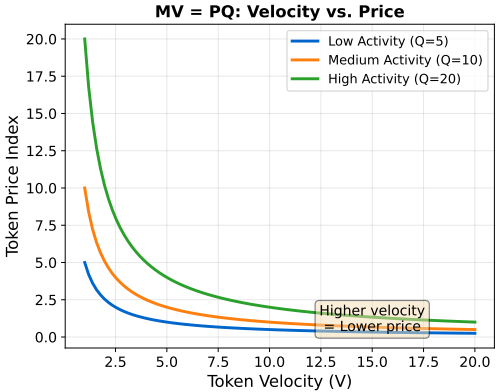
- M = Money supply (token supply)
- V = Velocity (transaction frequency)
- P = Price level
- Q = Quantity of goods/services

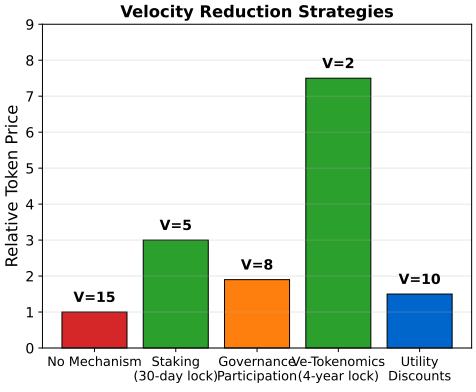
Solutions:

- Staking mechanisms (reduce velocity)
- Vesting periods
- Utility that requires holding (governance, fee discounts)

Key point: Equation of Exchange

Token Velocity and Price Dynamics





Higher velocity suppresses price; ve-tokenomics (4-year locks) most effective at reducing velocity

Pseudocode: Token Vesting Schedule

Linear Vesting with Cliff

```
function claimable_tokens(beneficiary):
  if current_time < cliff_end:
    return 0 // Nothing before cliff
  elapsed = current_time - vesting_start
  total_vesting_period = 4 years
  vested = total_allocation * (elapsed / total_vesting_period)
  vested = min(vested, total_allocation) // Cap at 100%
  claimable = vested - already_claimed
  return claimable
```

Key Insight: Vesting reduces velocity by preventing immediate selling. A 1-year cliff + 4-year linear vesting is the industry standard. Without vesting, insiders could dump tokens at launch, crashing prices.

Vesting is a velocity control mechanism: tokens locked today cannot be sold, reducing sell pressure

What Creates Balance: Token Sinks vs. Faucets?

Token Sinks (Removal)

- Transaction fee burns
- Protocol penalties (slashing—automatic destruction of staked tokens as punishment for misbehavior)
- Staking locks
- Governance participation locks

Effect: Reduce circulating supply, increase scarcity.

Token Faucets (Creation)

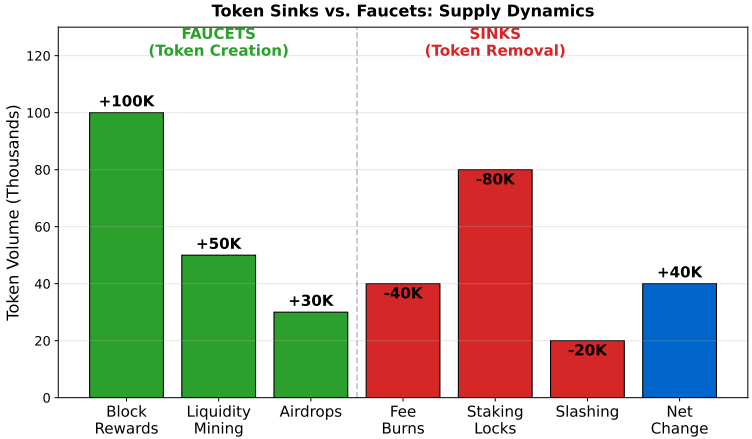
- Block rewards
- Liquidity mining rewards
- Airdrops
- Developer grants

Effect: Increase supply, incentivize participation.

Balance: Healthy tokenomics requires equilibrium between sinks and faucets.

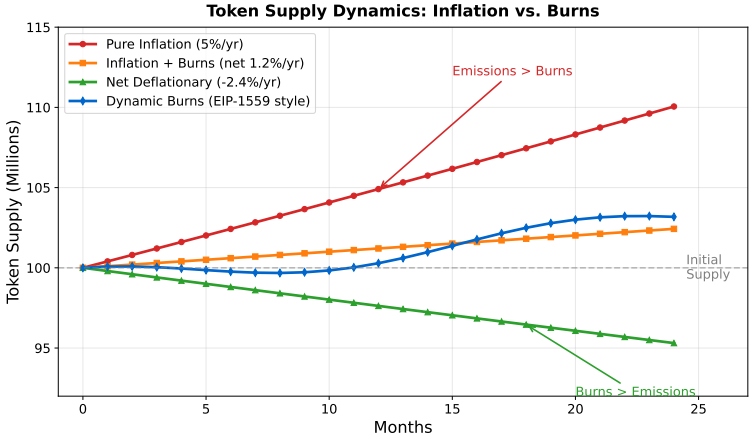
Compare the approaches shown above

Token Supply Dynamics



Healthy tokenomics balances faucets (creation) with sinks (removal) — Equilibrium between token creation and removal prevents hyperinflation or deflationary spirals

Supply Dynamics: Inflation vs. Burns



Pure inflation expands supply; burns can offset or exceed emissions; dynamic burns (EIP-1559) respond to network activity

How Did Ethereum's Tokenomics Evolve?

Pre-EIP-1559:
(Before Aug 2021)

- 4.5% inflation
- All fees to miners
- Unpredictable fees

Post-EIP-1559:

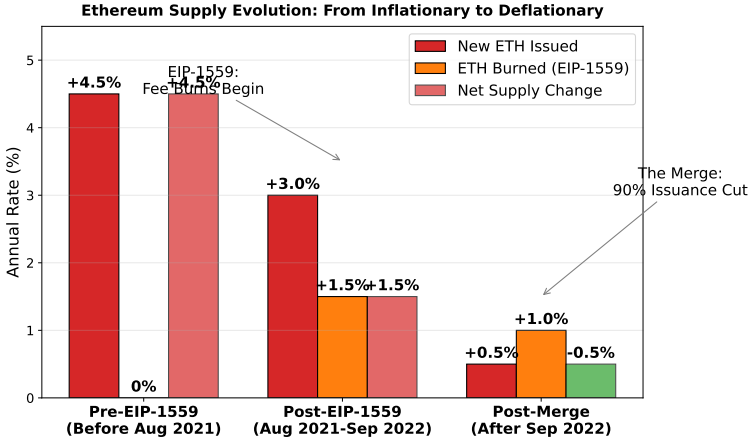
- Base fee burned
- Tips to miners
- Predictable fees

Post-Merge:
(Sept 2022)

- Issuance -90%
- Net deflationary
- 3-5% staking APR (Annual Percentage Rate—simple yearly interest without compounding)

Compare the approaches shown above

ETH Supply Evolution



EIP-1559 introduced burns; The Merge cut issuance 90%, achieving net deflation

How Do You Spot Bad Tokenomics?

Good Tokenomics

- Clear value accrual
- Sustainable incentives
- Low initial team/VC allocation
- Long vesting periods
- Transparent distribution
- Real utility beyond speculation

Bad Tokenomics

- No clear value capture
- Ponzi-like dynamics
- High team/insider allocation
- Short/no vesting
- Opaque distribution
- Pure speculation

Red Flags:

- Excessive token supply to insiders (¿30%)
- Unsustainable yield promises (¿100% APY)

Compare the approaches shown above

What Metrics Should You Check First?

1. **Circulating vs Total Supply**
   Large gap = future dilution
2. **Token Distribution**
   Top holder concentration, team %
3. **Inflation Rate**
   Current and projected annual
4. **Value Accrual**
   Fee sharing, burns, staking
5. **Unlock Schedule**
   When do vested tokens circulate?

Key: Evaluate all metrics together for complete picture

Compare the approaches shown above

Problem Solved? Token Economics

The Original Problem

How do we create sustainable token economies that don't collapse?

How Token Economics Solves It

- Fixed (BTC), inflationary (ETH pre-merge), or deflationary (BNB burns) – predictable monetary policy
- Fee distribution, staking rewards, token burns create organic demand
- Staking locks and governance utility reduce sell pressure

Remaining Limitations

- Even well-designed tokens suffer from price volatility unrelated to fundamentals
- Token velocity, holder psychology, and market cycles are hard to model

Open Questions

- What makes a token economy sustainable long-term? (No token has survived multiple market cycles with stable demand)
- Risk: Incentive misalignment if team allocations are excessive or vesting too short

Token Economics provides frameworks but no guarantees – success depends on execution and market conditions

The Economics of Token Economics

Incentive Structure

- Aligning individual and collective interests
- Rewards for honest behavior, penalties for cheating
- Protocol gains security, participants earn rewards

Economic Security

- Attack cost must exceed potential gain
- Honest behavior = Nash equilibrium (a game theory state where no player benefits from changing strategy unilaterally)

Cryptoeconomic security: Honest behavior must be the Nash equilibrium

Key Economic Question

Who Pays, Who Earns?

Protocol gains security, participants earn rewards

Design Principle

$$\text{Attack Cost} > \text{Potential Gain}$$

Design Space

Design Space: Token Economics

Alternatives Considered

1. **Chosen Design:** Reward curves, slashing conditions
2. **Alternative:** Alternative reward mechanisms

Trade-offs Made

- Every design optimizes some properties
- ... at the expense of others

Design Questions

- What would YOU change?
- What's optimized? What's sacrificed?
- Are there other approaches?

Key Insight

No Perfect Solution

All blockchain designs involve trade-offs between decentralization, security, and scalability.

Every design is a trade-off. Understanding alternatives reveals the "why" behind choices.

Failure Modes: Token Economics

Critical Failure Mode

- **What breaks:** Incentive misalignment, free-rider problems
- **Why it happens:** Economic incentives misaligned

Root Cause

- Assumption violated
- Incentive structure broken
- External shock

Historical Context

- Multiple real-world failures documented
- Patterns repeating across protocols

Early Warning Signs

- ! Unusual economic behavior
- ! Incentive misalignment
- ! Centralization drift

Prediction: What could cause this to fail? How would you detect it early?

The Inflation-Deflation Tug of War

[COMIC: Inflation vs deflation tension]

A visual narrative showing the perpetual struggle between inflationary emission and deflationary burns

What We Learned

- Token supply schedules create predictable scarcity
- Burns (EIP-1559, BNB) counteract inflation
- No perfect balance exists—all choices are trade-offs

The Takeaway

Sustainable tokenomics requires careful equilibrium between token creation incentives and value preservation.

Visual synthesis: The ongoing battle that defines every token economy

Summary

Key Takeaways:

- Token type determines purpose and regulatory treatment
- Value accrual mechanisms connect token price to protocol success
- Supply models (fixed, inflationary, deflationary) have trade-offs
- Good tokenomics aligns incentives across all stakeholders
- Token velocity must be managed to maintain value
- Transparent distribution and vesting are crucial

Next Lecture: Distribution and Vesting - How tokens are allocated and released over time.

Next Lesson: L30 – Distribution and Vesting

Key point: Key Takeaways

Reflection

Questions for Reflection

1. How does Bitcoin's fixed supply model compare to Ethereum's flexible issuance?
2. What are the trade-offs between utility tokens and governance tokens?
3. How can a protocol reduce token velocity without harming liquidity?
4. Why might high team/VC allocations be problematic?
5. What role do token burns play in value accrual?

Key point: Questions for Reflection

Quiz Questions (1–5)

Q1. Which of the following best defines tokenomics?
A) The price of a cryptocurrency B) The study of economic systems governing token creation and management
C) Mining difficulty algorithms D) Exchange trading volumes
Answer: B – Tokenomics encompasses token design, distribution, incentives, and value capture.

Q2. What is the primary characteristic of a utility token?
A) Represents ownership in a company B) Grants access to platform services
C) Provides voting rights only D) Functions as digital gold
Answer: B – Utility tokens are required for platform interaction and service access.

Q3. According to the Howey Test, which criterion does NOT determine if a token is a security?
A) Investment of money B) Common enterprise
C) Token name includes "coin" D) Expectation of profits from others' efforts
Answer: C – The Howey Test has 4 criteria; token naming is not one of them.

Q4. What is the maximum supply of Bitcoin?
A) 18.5 million B) 21 million C) 100 million D) Unlimited
Answer: B – Bitcoin has a predetermined cap of 21 million BTC.

Q5. Which token provides an example of governance functionality?
A) BTC B) USDT C) UNI D) WBTC
Answer: C – Uniswap (UNI) allows holders to vote on protocol changes.

Quiz Questions (6–10)

Q6. What is the purpose of EIP-1559 in Ethereum's tokenomics?
A) Increase block size B) Burn base fees to reduce supply
C) Eliminate all transaction fees D) Double staking rewards
Answer: B – EIP-1559 burns the base fee, creating a deflationary mechanism.

Q7. Which value accrual mechanism directly distributes protocol revenue to token holders?
A) Token burns B) Fee distribution
C) Halving events D) Airdrops
Answer: B – Fee distribution shares protocol fees with token holders (e.g., GMX).

Q8. In the equation of exchange ($MV = PQ$), high token velocity (V) typically:
A) Increases token price B) Suppresses token price
C) Has no effect on price D) Doubles the money supply
Answer: B – High velocity means tokens change hands quickly, suppressing price.

Q9. What is BNB's target supply after all burns are complete?
A) 50 million B) 100 million C) 144 million D) 200 million
Answer: B – BNB aims to burn from 200M initial supply down to 100M.

Q10. Which of these is a "token sink" (removes tokens from circulation)?
A) Block rewards B) Liquidity mining C) Staking locks D) Airdrops
Answer: C – Token sinks reduce circulating supply; staking locks achieve this.

Quiz Questions (11–15)

Q11. What happened to ETH issuance after The Merge in September 2022?
A) Increased by 90% B) Stayed the same
C) Reduced by 90% D) Stopped completely
Answer: C – The Merge cut issuance from 4.5% to 0.5% annually.

Q12. Which emission schedule model does Bitcoin use?
A) Linear emission B) Exponential decay
C) Halving events (decreasing emission) D) Algorithmic adjustment
Answer: C – Bitcoin halves block rewards every 210,000 blocks (4 years).

Q13. What is a major red flag in tokenomics design?
A) Long vesting periods B) Transparent distribution
C) Team/insider allocation exceeding 30% D) Fee sharing mechanism
Answer: C – Excessive insider allocation risks dumping and misaligned incentives.

Q14. Which strategy can reduce token velocity?
A) Encouraging frequent trading B) Staking mechanisms with lock-up periods
C) Removing governance rights D) Increasing transaction fees to 50%
Answer: B – Staking locks tokens, reducing velocity and sell pressure.

Q15. What does a large difference between circulating supply and total supply indicate?
A) Strong tokenomics B) Future dilution risk
C) Deflationary pressure D) High demand
Answer: B – Unvested tokens entering circulation can dilute existing holders.

Quiz

Quiz Questions (16–20)

Q16. Which token is an example of a "store of value" token?
A) LINK B) UNI C) BTC D) BNB
Answer: C – Bitcoin is designed as digital gold with limited supply.

Q17. What is the primary function of governance tokens?
A) Pay network fees B) Enable decentralized voting on protocol changes
C) Generate passive income D) Facilitate cross-chain transfers
Answer: B – Governance tokens allow holders to vote on protocol decisions.

Q18. In a deflationary token model, what happens to circulating supply over time?
A) Increases steadily B) Remains constant
C) Decreases through burns D) Doubles every 4 years
Answer: C – Deflationary models reduce supply via token burns.

Q19. What percentage of trading fees does GMX distribute to token holders?
A) 10% B) 20% C) 30% D) 50%
Answer: C – GMX distributes 30% of trading fees as value accrual.

Q20. Which year is Bitcoin's final BTC estimated to be mined?
A) 2040 B) 2100 C) 2140 D) 2200
Answer: C – Bitcoin's final coin is projected to be mined around 2140.