6. Role-Based Access Control (RBAC)

To ensure operational security and controlled delegation of infrastructure responsibilities, RMBT employs a Role-Based Access Control (RBAC) model across all smart contracts. This structure enables decentralized yet secure participation from multiple stakeholders, including municipalities, developers, investors, contractors, and automated sensors.

RBAC is enforced through OpenZeppelin's `AccessControl` library, a widely adopted Solidity standard that allows dynamic assignment, revocation, and verification of roles. All permissions within the protocol are linked to specific smart contract roles that map to real-world governance and operational responsibilities.

The following roles are currently defined within the RMBT protocol:

ADMIN_ROLE

Permissions:

- Global configuration of the ecosystem
- Deployment and upgrading of modules
- Assignment and revocation of roles
- Oversight of integration and linking contracts

Examples:

- Deploying a new staking pool
- Assigning `CITY_OPERATOR` rights to a municipality
- Modifying SDG weighting parameters

This role is reserved for DAO-elected multisig accounts or system administrators during pilot phases.

CITY_OPERATOR

Permissions:

- Launch toll contracts for approved roads
- Mint and manage StreetNFTs
- Configure and maintain staking pools
- Update infrastructure metadata

Examples:

- Registering a new toll-enabled street
- Adjusting toll rates on high-traffic days
- Reassigning staking pools after road expansion

`CITY_OPERATOR` is typically assigned to municipal agencies or contracted urban infrastructure platforms.

INVESTOR

Permissions:

- Stake RMBT into approved infrastructure assets
- Claim yield based on verified asset performance
- Participate in DAO voting and governance proposals

Examples:

- Staking RMBT into a smart bridge in São Paulo
- Earning yield bonuses after energy SDG goals are met
- Voting on proposals for token burns or grant disbursements

`INVESTOR` is the most widely accessible role and forms the foundation of RMBT's citizen-stakeholder model.

CONTRACTOR

Permissions:

- Receive milestone-based payouts in USDT or RMBT
- Submit proof-of-completion for infrastructure projects
- Interact with DAO task tracking and funding modules

Examples:

- Triggering payment after completing a toll booth
- Uploading blueprints or sensor data as audit evidence
- Receiving bonuses for ahead-of-schedule delivery

`CONTRACTOR` accounts are time-bound and limited to the scope of verified smart Build-Operate-Transfer (BOT) agreements.

ORACLE

Permissions:

- Submit off-chain metrics related to SDG performance
- Validate energy output, foot traffic, or environmental data
- Influence contract logic through verified real-world events

Examples:

- Sending live air quality readings for SDG 13 metrics
- Verifying solar output from a decentralized energy grid
- Submitting foot traffic for walk-to-earn modules

Oracles must be pre-approved and may include IoT devices, civic institutions, or third-party validators. Their data is cryptographically signed and submitted on-chain for transparency and trust.

On-Chain Role Enforcement

Access to role-restricted functions is programmatically enforced in Solidity using statements such as:

```
require(hasRole(CITY_OPERATOR, msg.sender), "Not authorized");
```

Role assignments and removals are managed using:

```
grantRole(bytes32 role, address account)
revokeRole(bytes32 role, address account)
```

Administrators and DAO proposals may invoke these methods to ensure responsive, adaptive governance.

RBAC is a critical safeguard that ensures the RMBT protocol remains secure, scalable, and compliant with institutional-grade role management, without compromising on decentralization or modularity.

7. DAO Governance

Governance within the RMBT ecosystem is not an afterthought or optional add-on. It is a foundational design principle that is embedded directly into every aspect of infrastructure deployment, upgrade, and funding. The RMBT governance system is built on a Decentralized Autonomous Organization (DAO) model that allows stakeholders to collectively propose, vote on, and implement decisions that shape the future of infrastructure assets, the token economy, and strategic development.

7.1 Purpose and Philosophy of the RMBT DAO

In traditional infrastructure ecosystems, decision-making is siloed, bureaucratic, and often inaccessible to the very people affected by those decisions. Contractors and municipalities operate behind closed doors, while citizens and investors remain passive observers. RMBT flips this model by placing stakeholders at the center of governance. Whether you are a municipality, citizen-staker, developer, or data validator, the DAO enables you to participate directly in shaping how infrastructure is built, funded, maintained, and rewarded.

The DAO serves multiple core functions:

- **Proposal and voting system** for any changes in contract logic, asset onboarding, budget allocation, or DAO treasury disbursement.
- **Community treasury management** that funds contractors, auditors, developers, and researchers through transparent voting.
- **Inflation control and token issuance** through tightly scoped and purpose-driven minting mechanisms.
- **SDG compliance governance** that rewards performance-based infrastructure with yield boosts or treasury grants.

7.2 Quadratic Voting for Equitable Influence

The RMBT DAO implements quadratic voting to ensure democratic participation without letting token-rich actors dominate governance. In quadratic voting:

- One vote costs 1 token
- Two votes cost 4 tokens
- Three votes cost 9 tokens, and so on

This system means that while those with more RMBT have greater influence, the marginal cost of influence grows exponentially, making it costly to monopolize

decision-making. This encourages broad participation and protects against governance capture.

Quadratic voting is executed through verified, on-chain smart contracts, and all vote results are published for full auditability.

7.3 Governance Cycle and Proposal Types

RMBT governance follows a structured proposal lifecycle:

1. **Proposal Creation**: Any verified user with sufficient RMBT or DAO reputation score can create a proposal.
2. **Discussion Phase**: The proposal is posted on the governance dashboard and discussed by the community.
3. **Voting Period**: Token holders vote with RMBT using quadratic weighting.
4. **Execution or Rejection**: If the quorum is met and majority approved, the proposal is executed on-chain.

Supported proposal types include:

- Contract upgrade requests
- New city token issuance
- Infrastructure funding proposals
- Developer grants and hackathon funds
- DAO reward adjustments
- Treasury burn proposals
- SDG compliance initiatives

All proposals are categorized, version-controlled, and stored on-chain for transparency and traceability.

7.4 Treasury Management and Grant Disbursement

The DAO treasury holds a percentage of RMBT tokens and incoming toll revenues for community-driven allocations. Proposals to allocate these funds may include:

- Paying smart contractors for verified milestone completion
- Funding developers building extensions or modules for the RMBT SDK
- Subsidizing clean energy installations through pyro-tile incentives
- Issuing retroactive public goods grants for off-chain contributions

Smart contracts such as

```
propose(uint8 type, uint256 amount, bytes calldata data)
execute(uint256 proposalId)
```

govern treasury flows, ensuring that only approved decisions result in fund movements.

A portion of the treasury is allocated toward DAO voter rewards. Participants who consistently vote on key proposals or serve as metric reporters (oracles) are compensated in RMBT for their civic engagement.

7.5 Controlled Minting and Inflation Logic

Unlike many projects with unrestricted mint functions, RMBT follows a governed token issuance model. New RMBT tokens can only be minted under specific, verifiable conditions:

- Onboarding of a new city or infrastructure network
- DAO-approved capacity expansions
- Release of milestone-based community grants

Each minting request is accompanied by:

- A defined cap or issuance amount
- A linkage to a real infrastructure asset (via NFT or toll logic)
- A staking pool or treasury buffer to absorb liquidity

Minting is executed through a DAO-controlled smart contract and can only occur after the proposal is approved through quorum-based, time-locked governance mechanisms.

This ensures inflation remains purpose-driven and tied to network growth, preventing supply dilution and maintaining token utility integrity.

7.6 SDG-Driven Governance Outcomes

The DAO is also responsible for managing how Sustainable Development Goal (SDG) compliance maps to financial and governance incentives. For example:

- If a road segment exceeds air quality benchmarks or foot traffic goals, a proposal may trigger yield increases for stakers.
- If an energy grid produces surplus verified green energy, the DAO may disburse retroactive RMBT incentives to the operators.

This SDG-aligned governance design ensures that ethical infrastructure development becomes economically superior, not just morally favorable.

7.7 Governance Dashboard and Participation Interface

A user-facing DAO dashboard enables real-time participation in governance decisions. Features include:

- Proposal submission forms with metadata fields
- Active and historical vote tracking
- Treasury balance and pending disbursements
- Reward claim portal for DAO participants

Wallet-based login via TronLink is supported, and governance functions are accessible through both web and mobile interfaces. All transactions are verified via cryptographic proofs and visible via blockchain explorers for full transparency.

7.8 Long-Term Governance Vision

As RMBT expands to new cities and verticals, the DAO is expected to evolve into a network-level meta-governance structure, where sub-DAOs representing individual cities or infrastructure classes have their own governance modules. These sub-DAOs will interoperate with the core DAO for budget requests, technical upgrades, and compliance alignment, forming a federated infrastructure governance network.

The DAO ensures RMBT remains community-aligned, economically agile, and politically neutral, capable of operating across jurisdictions, time zones, and user demographics.

In doing so, it transforms not just how infrastructure is built, but who decides what gets built, maintained, and rewarded—placing that power in the hands of a global, on-chain community.

8. Tokenomics & Economic Model

The RMBT token is the foundational economic instrument of the decentralized infrastructure economy. Designed to function not as a speculative asset but as a utility-based, performance-linked currency, RMBT drives every interaction in the ecosystem — from toll payments and staking rewards to governance, maintenance incentives, and real-time performance feedback.

8.1 Token Identity and Characteristics

- **Token Name:** RMBT
- **Token Type:** TRC-20 (TRON standard)
- **Initial Supply:** 750,000 RMBT
- **Supply Model:** Dynamic and DAO-governed
- **Backing Model:** Diversified asset portfolio (see below)
- **Circulating Basis:** Participation-driven earning, not pre-allocation

Unlike conventional cryptocurrencies that rely on pre-sales, airdrops, or liquidity farming, RMBT employs a proof-of-utility issuance model. Tokens are earned as a result of value-generating activity across the ecosystem — not through speculation or passive holding. This ensures that token flow aligns directly with network growth and infrastructure usage.

8.2 Core Token Utilities

RMBT has a diverse set of integrated uses, all tied to real-world infrastructure participation:

- **Toll Payments:** RMBT is used to access tokenized infrastructure such as roads, rail hubs, and energy systems
- **Staking Mechanism:** Citizens and investors can stake RMBT into infrastructure pools and earn proportional returns based on usage and SDG performance
- **Governance Participation:** RMBT holders can propose, vote on, and execute DAO decisions
- **Performance Bonuses:** Users, oracles, and contractors receive RMBT rewards for actions that meet SDG metrics
- **City Token Conversion:** RMBT can be wrapped or swapped into localized infrastructure tokens (e.g., $LHRroad, $KHIroad)

- **Vendor Settlement:** Municipalities, contractors, and suppliers may receive RMBT or stablecoin equivalents via RMBT liquidity channels

8.3 Value Distribution Model

In contrast to legacy crypto projects where token allocation privileges early liquidity providers or speculators, RMBT uses a network benefit model. Tokens are redistributed to actors based on verified value contributed to the ecosystem:

Category	Role in Ecosystem	Benefit Model
Infrastructure Users	Drivers, riders, pedestrians	Micro-rewards via toll flows, energy generation
Stakers	Individual or pooled investors	Yield from actual usage and SDG goal performance
Oracles	Data submitters (pollution, energy, traffic)	RMBT for verified, signed submissions
Governance Participants	Voters, proposers, metric evaluators	DAO voter reward allocation
Contractors	Builders and system integrators	Milestone-based payouts from DAO treasury
City Operators	Municipal stakeholders	Earn governance rights and local token revenue

This participatory design ensures that every transaction across the network contributes to shared economic value, rather than privileging a narrow investor class.

8.4 Adaptive Allocation Framework (Macro-Level Transaction Flow)

Unlike many blockchain ecosystems that rely on speculative token pre-mines or upfront distributions, RMBT follows an adaptive, DAO-controlled issuance model designed to reward meaningful participation and network activity.

In the TRON ecosystem, gas fees are paid in Energy or Bandwidth, and those fees are absorbed by the TRON network itself. RMBT is not designed to capture these native fees directly. Instead, it introduces an internal value redistribution model, where every on-chain interaction such as staking, toll payments, energy reporting, or governance, all generates network activity that results in token-based dividends across the ecosystem.

Rather than extracting value from users, RMBT channels it back into the community through modular economic circuits built around usage, performance, and contribution.

The following allocation buckets represent maximum thresholds for how RMBT may flow back into the network in response to real participation. These are not fixed distributions, but dynamic ceilings managed transparently by the DAO.

Allocation Bucket	Maximum Threshold	Purpose
Ecosystem Incentives	25%	Performance-based rewards for staking, SDG milestones, oracle accuracy, and DAO participation
Development & Innovation Pool	20%	Continuous funding for toolkit upgrades, audits, integrations, and developer grants
DAO Treasury	15%	Voting-driven allocations for infrastructure grants, emergency funding, and proposal execution
Liquidity Channels	20%	Ensure stable swaps between RMBT, USDT, and city tokens; support vendor settlement and ecosystem payments
Protocol Stewards	5%	Time-locked allocation for founding contributors, technical governance, and long-term ecosystem mentorship

City Integration Grants	10%	Municipal onboarding, validator network bootstrapping, and localized DApp adoption
Burn Reserve	5%	Controlled deflation via DAO-approved supply reductions to maintain long-term value integrity

Each of these allocations is governed by on-chain proposals, subject to DAO quorum and time-locks. No entity or founder can access funds unilaterally. Every transaction that occurs in the ecosystem — whether paying tolls, reporting energy, or voting in governance — contributes to a circular flow of value back to the stakeholders who power the protocol.

This model positions RMBT not only as a utility token, but as a network-wide reward mechanism, where the more the protocol is used, the more benefits are distributed to those who enable its success.

8.5 Investment Portfolio Backing

RMBT is partially backed by a diversified asset portfolio that reflects the treasury's economic resilience and its commitment to long-term infrastructure sustainability.

Asset Class	Allocation	Rationale
Fiat Reserves	35%	Provides stability and liquidity for vendor payments
Government Bonds	20%	Secures low-risk returns and credibility
Stocks & ETFs	20%	Growth exposure across multiple economies
Web3 Projects	15%	Ecosystem synergy and DeFi collaboration opportunities

Strategic Ventures	10%	Partnerships with climate tech, energy, and infra startups

This diversified treasury ensures that DAO initiatives are funded not just through token minting, but through real-world financial instruments that generate passive income and reinforce stability.

8.6 Philosophy Behind Supply and Inflation

RMBT does not adhere to a fixed hard cap or infinite minting. Instead, it follows a governed issuance model, in which new supply is minted only when tied to measurable, value-generating events such as:

- Onboarding new cities or infrastructure modules
- Funding SDG-certified upgrades or expansions
- Rewarding DAO-level participation metrics

All minting is governed by a proposal-and-quorum process, with on-chain execution and enforced time locks. This ensures that supply growth is purpose-driven, deflation-aware, and always matched by network activity or reserve requirements.

14. Strategic Use Case Layers

The RMBT protocol is built with a modular and programmable architecture, allowing it to support a wide range of real-world infrastructure applications. These are not siloed solutions, but interconnected verticals that operate on a unified logic framework: each infrastructure element is tokenized, assigned programmable income mechanisms, and aligned with SDG-based yield incentives.

The following strategic use case layers demonstrate how RMBT can be implemented across core urban systems, creating an intelligent, revenue-generating, and impact-driven ecosystem for modern cities and decentralized communities.

14.1 Transportation Infrastructure

Transportation is one of the first and most obvious beneficiaries of RMBT's architecture.

a) Smart Toll Roads

RMBT enables real-time, micro-level tolling on urban and regional roads. Vehicles pay per meter or based on time-of-day, congestion level, or vehicle type. All toll payments are processed by smart contracts, which automatically distribute the revenue among multiple stakeholders such as:

- Local municipalities
- DAO treasuries
- Private investors
- Infrastructure contractors

Toll logic is customizable per region, and contract upgrades can be proposed via DAO governance.

b) NFT-Based Parking Zones

Parking spaces are tokenized as NFTs, each representing a defined physical slot. These NFTs can be:

- Sold or leased to residents or businesses
- Programmed with dynamic pricing based on demand
- Tracked in terms of usage to distribute staking yields or maintenance rewards

Users can book parking via apps integrated with the RMBT REST APIs, and stake tokens to reserve or earn from high-demand zones.

14.2 Energy Infrastructure

Energy is a natural extension of the RMBT model, especially for community-powered grids and micro-energy production.

a) Pyro-Tile and Renewable Grids

Tiles embedded in roads, sidewalks, or public buildings can generate electricity from kinetic or solar energy. These outputs are:

- Verified on-chain through oracle systems
- Tokenized and linked to kilowatt production
- Monetized through smart contracts, allowing institutions or municipalities to purchase clean energy directly from producers

Yield from energy generation is shared with citizens, infrastructure providers, and DAO participants.

b) Grid Tokenization

Local energy projects such as solar farms or hydroelectric plants can be tokenized into local project tokens (e.g., `$GYDEnergy`), tradable against RMBT and other stablecoins. These tokens can carry performance multipliers if the grid meets clean energy or sustainability benchmarks.

14.3 Water Management Systems

Water systems are increasingly under stress, making smart management essential.

a) Leakage Detection and Maintenance Incentives

Smart sensors can detect water leaks or usage anomalies in real time. These sensors are linked to RMBT contracts that:

- Trigger micro-payments to maintenance teams for real-time fixes
- Penalize overuse or provide bonuses for conservation
- Push data to city dashboards for proactive planning

This makes the water grid more responsive and accountable, while enabling staking into water conservation projects.

b) Water Tokenization

Water supply zones can be tokenized into access NFTs, especially in regions with tiered or limited water rights. Smart contracts can dynamically price water access based on consumption or scarcity.

14.4 Waste Management

RMBT redefines waste handling from a cost center into an incentivized civic service.

a) Smart Collection Contracts

Garbage collection routes and bins are equipped with IoT sensors that trigger payment contracts upon successful and verified pickups. These contracts allow:

- Citizens or micro-entrepreneurs to earn for collecting recyclable or organic waste
- Municipalities to automate payments per collection or per ton
- DAO grants for neighborhoods with higher recycling rates

b) Recycling Incentives

Token-based bonuses can be provided to communities that meet waste reduction goals, contributing to SDG 12 (Responsible Consumption & Production) and SDG 13 (Climate Action). This aligns everyday activities with token rewards, fostering community-led sustainability.

14.5 Unified Logic Across All Layers

Despite the diversity of use cases, all modules in the RMBT ecosystem share a unified operational structure:

Layer Component	Description
Tokenized Asset	Each infrastructure element is registered as an NFT or smart contract unit

Programmable Income	Revenues (tolls, energy, waste pickups) are processed through contracts
SDG Yield Incentive	Verified performance against SDG goals increases staking rewards or voting power

This modularity ensures any new infrastructure layer—whether it's street lighting, broadband, urban farming, or even public art—can be rapidly onboarded using the same core principles.

14.6 Future Expansion Potential

Beyond transportation, energy, water, and waste, future use cases may include:

- **Telecommunications infrastructure** (tokenized nodes, mobile points, mesh networks)
- **Healthcare facilities** (rewarded access, foot traffic, DAO-funded public health programs)
- **Education systems** (impact-linked DAO grants for student engagement and attendance)
- **Public internet and surveillance** (privacy-conscious staking and uptime rewards)

RMBT's architecture is designed to evolve with emerging needs, offering developers and municipalities a plug-and-play framework to launch, manage, and monetize smart infrastructure anywhere in the world.