

CarbonMove Whitepaper

Transforming Daily Commitment into Verifiable Climate Action

Version 1.0

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Abstract. Climate change continues to intensify, while most individual sustainable behaviors, such as walking instead of driving, using public transport, recycling, and conserving energy, remain unrecognized, unverifiable, and economically disconnected from climate action frameworks. CarbonMove introduces a blockchain-based ecosystem that transforms verified everyday sustainability actions into measurable, traceable climate impact. Built on the CarbonMove Chain, a purpose-designed Layer 2 blockchain, and powered by the Proof of Commitment (PoC) consensus mechanism, CarbonMove verifies real-world eco-actions using sensor fusion, machine learning, and privacy-preserving zeroknowledge proofs. Verified actions are rewarded with CarbonMove Tokens (CMT), a utility token backed by scientifically derived CO₂ reduction estimates based on Life Cycle Assessment (LCA) principles. CarbonMove provides a unified, tamper-proof infrastructure enabling individuals, communities, and institutions to participate in global decarbonization with transparency, accountability, and economic value.

1. Introduction

Anthropogenic greenhouse gas (GHG) emissions are accelerating climate change, affecting ecosystems, economies, and human health. Global frameworks such as the Paris Agreement, UN Sustainable Development Goals (SDGs), and international standards (ISO 14064, ISO 14067, ISO 14068) guide organizations and nations toward net-zero emissions by 2050. Large-scale carbon reductions and crediting schemes exist for corporations and governments, validated through rigorous methodologies. Despite their massive cumulative potential, individual-level climate-positive behaviors remain largely unmeasured and unrewarded. Current systems face several challenges in addressing this gap. There is no unified infrastructure capable of aggregating daily eco-actions, leaving countless small efforts unrecognized. Verification is also a significant hurdle, as traditional methods cannot reliably validate millions of micro-level behaviors. Additionally, there are few incentives for individuals to consistently make low-carbon choices, which limits widespread engagement and the overall impact of personal sustainability actions. Fragmentation between personal sustainability habits and formal climate accounting systems. CarbonMove addresses this global gap by providing a secure, verifiable, and reward-driven measurement system for individual sustainability actions. Using blockchain, sensor verification, and trusted environmental data, CarbonMove creates a direct pathway between personal behavior and meaningful climate impact.

2. Market Landscape & Competitive Positioning

The intersection of sustainability, behavioral incentives, and decentralized verification is rapidly emerging as one of the fastest-growing domains in climate technology. Current solutions in this space primarily focus on corporate carbon accounting platforms, carbon credit registries, offset marketplaces, and fitness-oriented “move-to-earn” apps, which often offer only limited authenticity verification. However, these systems seldom provide individual-level, sensor-verified CO₂ measurement with audit-grade integrity.

CarbonMove differentiates itself by introducing real-world verification through proof-of-commitment (PoC), rather than relying solely on step counting or self-reporting. By combining sensor fusion, machine learning, and zero-knowledge proofs (ZKPs), the platform ensures cryptographically assured authenticity of recorded actions. It's consistent, life cycle assessment (LCA)-grounded impact model links behaviors directly to verifiable CO₂ displacement, while a scalable micro-verification blockchain enables millions of daily validations. This unique combination positions CarbonMove at the forefront of the over \$100 billion sustainability and digital verification market, effectively bridging individual climate action with global impact systems.

3. The CarbonMove Solution

CarbonMove is a commit-to-earn ecosystem that transforms verified sustainability behaviors into tokenized environmental value. While most carbon accounting frameworks focus on emissions at organizational or national scales, CarbonMove decentralizes this approach by enabling individual-level measurement through standardized LCA-based CO₂ reduction factors, on-device data capture, proof-of-commitment (PoC) consensus for authenticity, immutable blockchain records, and privacy-preserving proofs.

The platform is guided by four core principles. First, it measures what matters, quantifying the displacement of carbon-intensive alternatives, such as kilometers walked instead of driven. Second, it verifies authenticity, ensuring that each recorded action is genuine, non-artificial, and contextually valid. Third, it rewards value, issuing tokens only for verified CO₂ reductions. Finally, it ensures transparency by maintaining an auditable, tamper-proof environmental dataset that users and stakeholders can trust.



4. Commit-to-Earn Workflow

Step 1 — Commit

Users engage in sustainable actions such as walking, cycling, using public transport, or recycling. Device sensors capture motion, GPS location, duration, and contextual data, which are then hashed and time-stamped within the user's wallet.

Step 2 — Verify

Validators authenticate each action using a combination of sensor fusion (GPS, accelerometer, gyroscope), motion-pattern analysis, machine-learning-based fraud detection, zero-knowledge proofs, and multi-node consensus. Only actions that meet strict integrity and authenticity thresholds qualify for reward issuance.

Step 3 — Reward

Validators authenticate each action using a combination of sensor fusion (GPS, accelerometer, gyroscope), motion-pattern analysis, machine-learning-based fraud detection, zero-knowledge proofs, and multi-node consensus. Only actions that meet strict integrity and authenticity thresholds qualify for reward issuance.

5. Evolutionary Roadmap

Phase 1 — Sustainable Mobility

This initial phase targets verified walking, running, and cycling activities, supported by the foundational proof-of-commitment (PoC) validator network and core LCA-based impact factors. A mobile MVP and testnet facilitate early user engagement and system testing

Phase 2 — Lifestyle & Consumer Expansion

The platform broadens to include micromobility options such as e-bikes and e-scooters, public transport integration through QR/ticket scans and geospatial matching, and AI-powered recycling verification. An early-stage marketplace ecosystem is also introduced to incentivize verified sustainable behaviors.

Phase 3 — Comprehensive Sustainability Platform

In its final phase, CarbonMove verifies green consumption via eco-label APIs, monitors energy savings through smart-meter IoT integration, and validates community actions like tree planting and cleanups. Full DAO governance is implemented alongside enterprise-grade verification-as-a-service APIs, enabling robust scalability and wide-reaching real-world impact.

6. Technology Architecture

6.1 CarbonMove Chain

CarbonMove Chain is a purpose-built Layer 2 blockchain designed to handle high-frequency microverifications with near-zero energy consumption while maintaining Ethereum interoperability and minimal transaction costs. It achieves on-chain integrity alongside off-chain computational efficiency.

Key Architectural Features:

- Energy-efficient consensus mechanism
- Smart-contract orchestration for token rewards, staking, and slashing
- Scalable throughput capable of processing millions of daily events
- Environmental data oracles supplying CO₂ intensity and LCA factors

6.2 Proof of Commitment (PoC) Consensus

The PoC consensus mechanism validates real-world environmental commitments rather than capital or computational work.

Core Components:

- **Validator Staking:** Establishes economic accountability
- **Sensor-Based Action Verification:** Confirms physical activity via device sensors
- **Trust Score:** ML-driven reliability metric for validators
- **Cross-Verification:** Ensures independent multi-node agreement

Technical Pipeline:

1. User generates action data, hashed locally
2. Zero-knowledge proof (ZKP) created to prove authenticity without exposing raw data
3. Validator nodes perform ML-based integrity checks
4. Cross-node consensus validates the action
5. Smart contract issues corresponding CMT reward

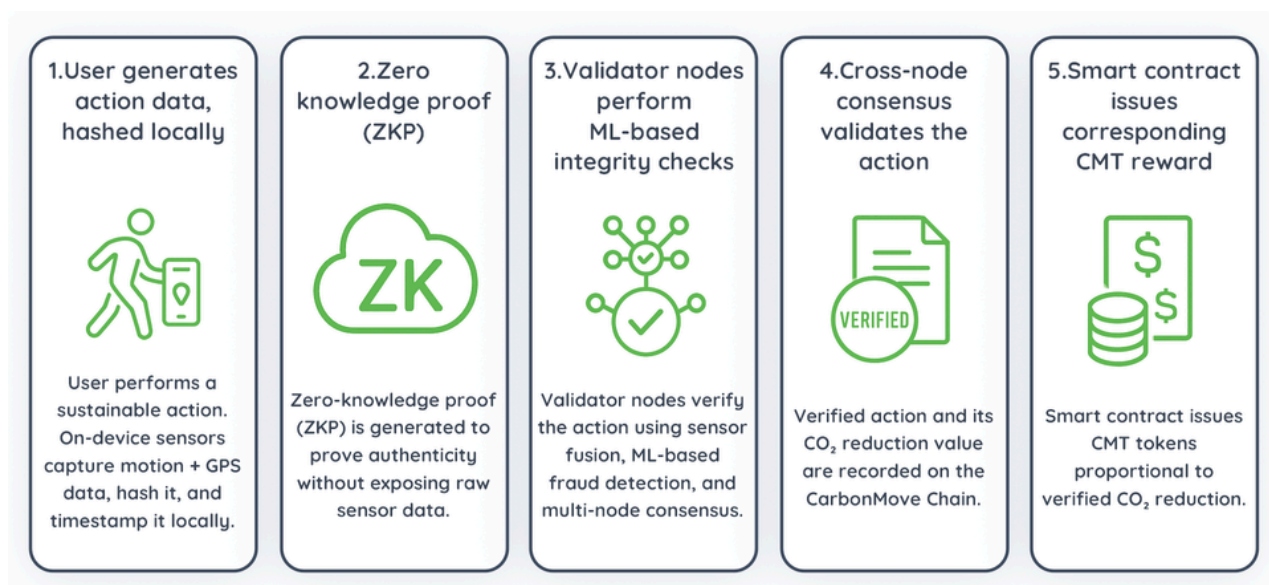
6.3 Integrity & Authenticity Verification Layer

This layer combines multiple verification signals to ensure only genuine climate-positive actions are rewarded:

Core Components:

- **Velocity & Motion Analysis:** Differentiates walking, cycling, vehicle transport, and nonhuman movement using kinematic profiles
- **GPS Drift & Ping Analysis:** Detects spoofing, relay attacks, or artificial location manipulation
- **ML-Based Risk Scoring:** Assigns a real-time fraud probability score to each action, influencing validator requirements

By integrating these signals, the system maintains high fidelity in verifying sustainable behaviors while preventing fraud or artificial inflation of CO₂ reductions.



7. Tokenomics: CarbonMove Token (CMT)

7.1 Token Overview

The CarbonMove Token (CMT) is a utility token representing verified sustainability actions, with a fixed supply of 1Bn tokens. Issuance of CMT is directly linked to quantifiable CO₂ reductions, ensuring that token creation reflects real-world environmental impact.

7.2 Utilities

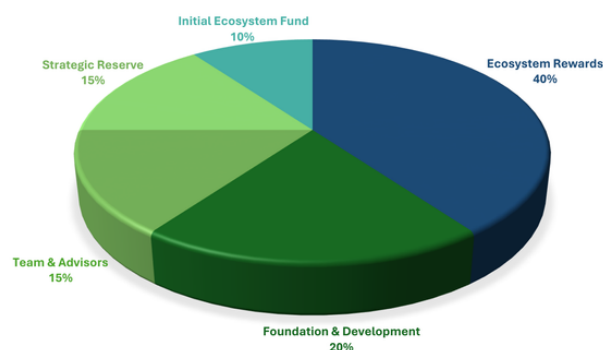
CMT serves multiple functions within the CarbonMove ecosystem:

- **Staking:** Required for validator participation
- **Reward Distribution:** Issued for verified eco-actions
- **Transaction Gas:** Used for operations on CarbonMove Chain
- **Governance:** Enables DAO voting on environmental factors and network parameters
- **Marketplace Currency:** Facilitates exchange of carbon offsets, green products, and certifications

7.3 Distribution

The token allocation is designed to balance ecosystem growth, development, and long-term stability:

- 40% - Ecosystem Rewards
- 20% - Foundation & Development
- 15% - Team & Advisors (subject to 4-year vesting)
- 15% - Strategic Reserve
- 10% - Initial Ecosystem Fund



7.4 Deflation & Stability Mechanisms

The CarbonMove Token (CMT) is designed with methods to keep its value stable and encourage honest participation. This system relies on deflationary mechanisms and incentives for good behavior. First, a Token Burn permanently removes a portion of transaction fees and marketplace commissions from the total supply. Second, the Slashing rule ensures validators who submit fake verifications lose their staked CMT, which is then burned. This makes cheating costly and reduces the token supply. Finally, a Buyback Program uses platform revenue to buy back CMT tokens, which also cuts the circulating supply, though these buybacks are conditional and not always guaranteed. These combined actions work to maintain the long-term integrity and value of CMT.

8. Validator Rewards & Vesting

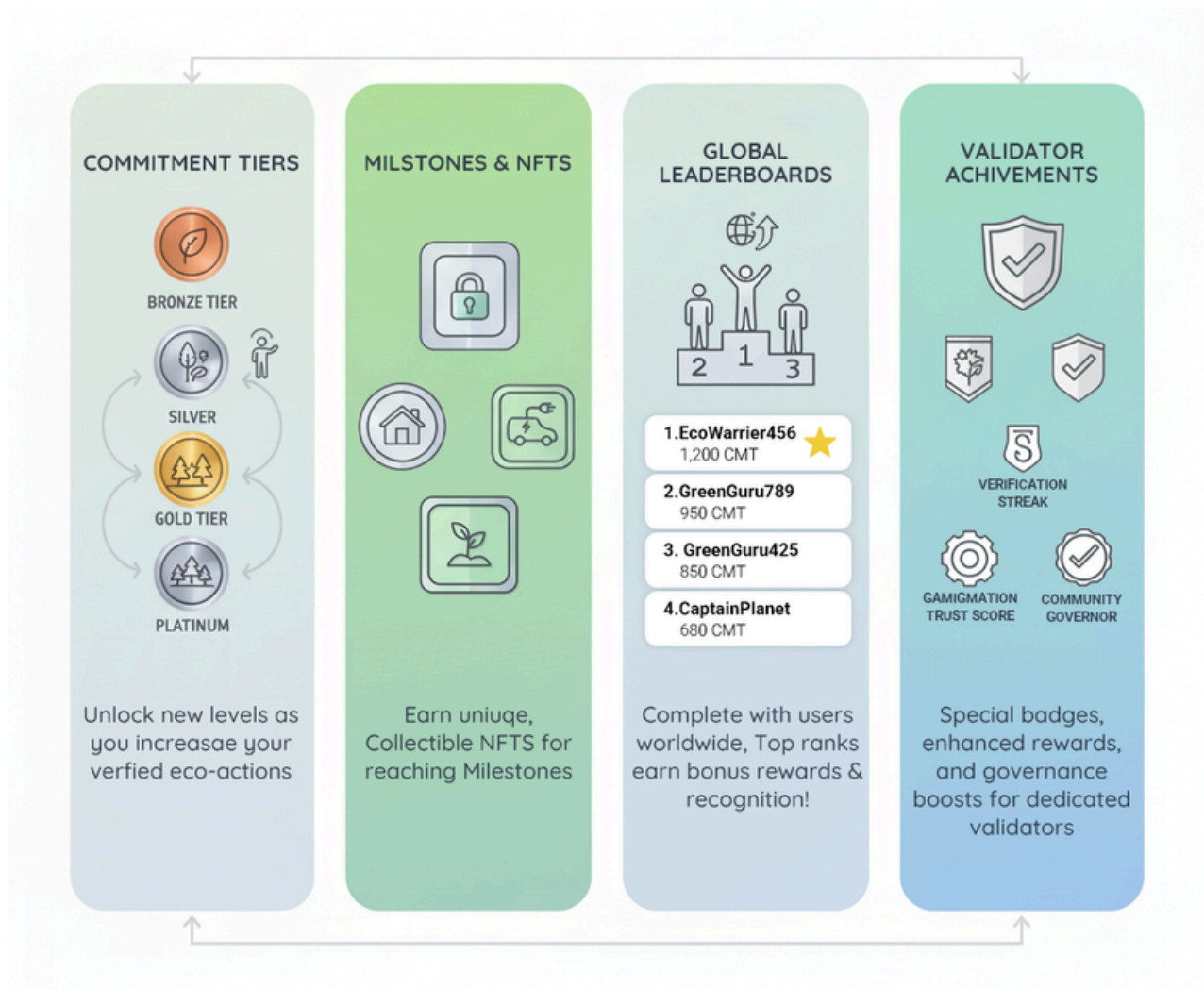
Validator rewards are structured to incentivize long-term participation and network reliability. The initial reward rate is defined as a percentage of staked tokens, with the exact rate specified in the mainnet parameters. Rewards are subject to dynamic adjustment based on factors such as staking participation, validator trust scores, and network inflation controls, ensuring balanced distribution and system stability. All rewards follow a 4-year vesting schedule, unlocking gradually to promote sustained engagement and long-term commitment to the CarbonMove ecosystem.

9. Adoption & Partnership Strategy

CarbonMove drives global adoption through strategic collaborations across public, private, and community sectors. Key initiatives include integrations with municipal transit systems, partnerships with recycling infrastructure providers, and collaborations with cities to advance Sustainable Development Goals (SDGs). Additionally, enterprise-focused verification APIs enable businesses to participate and contribute verified data, while community sustainability programs foster grassroots engagement. These partnerships not only expand the platform's verification coverage but also strengthen the authenticity and reliability of collected environmental data.

10. Gamification & User Engagement

CarbonMove harnesses behavioral science alongside Web3 mechanisms to encourage sustained, long-term participation in climate-positive actions. The platform incorporates commitment tiers, CO₂ milestone NFTs, global sustainability challenges, leaderboards, and validator achievement rewards to create a motivating and interactive experience. By turning verified eco-actions into rewarding and socially engaging activities, gamification helps embed sustainability as a habitual, enjoyable part of users' daily lives.

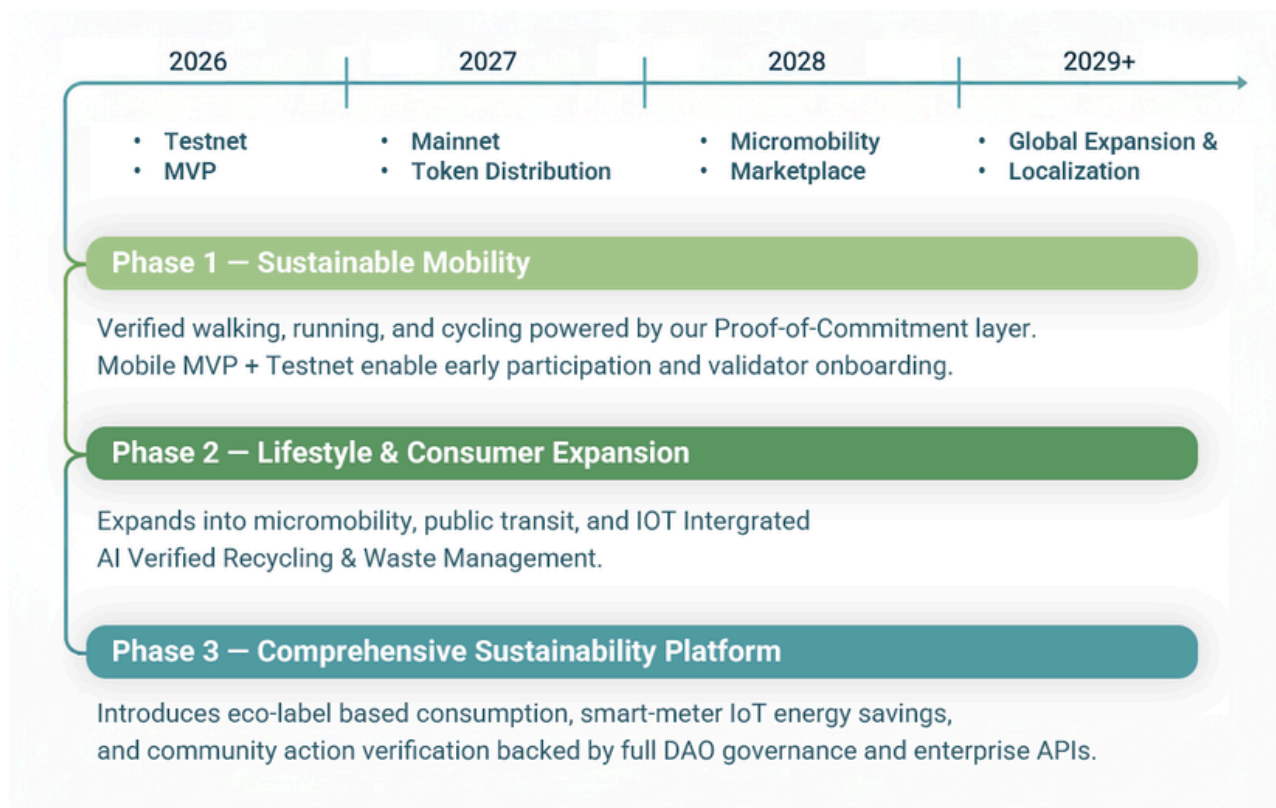


11. Market Opportunity & Growth Strategy

CarbonMove targets multiple converging growth sectors, positioning itself at the intersection of rapidly expanding markets. Sustainability and carbon markets are projected to exceed \$100 billion by 2030, while blockchain-based verification is an emerging sector valued at over \$50 billion. Additionally, behavioral incentive platforms are experiencing rapid global adoption, creating a fertile landscape for innovation.

- **2026:** Testnet launch, validator onboarding, mobile MVP
- **2027:** Mainnet launch, token distribution, expanded verification modules
- **2028:** DAO governance transition, enterprise APIs, cross-chain interoperability
- **2029+:** Global expansion, entry into new sustainability domains

This phased timeline supports strategic growth, broad adoption, and scalable environmental impact.



12. Economic Model & Environmental Sustainability

CarbonMove's economic model balances robust revenue generation with a strong commitment to environmental integrity. Revenue streams include network fees, marketplace commissions, verification-as-a-service, aggregated opt-in data insights, and premium features or API licensing. In parallel, the platform upholds its environmental responsibility through carbon-neutral blockchain operations, regular third-party environmental audits, and transparent emissions dashboards. Strategic collaborations with accredited offset programs further ensure that the platform's operations and growth remain aligned with verifiable climate-positive outcomes, reinforcing trust and credibility among users and partners.

13. Scientific Basis for Impact Measurement

CarbonMove's CO₂ quantification model is grounded in internationally recognized standards and best practices, including ISO 14067 for product carbon footprints, the GHG Protocol for emission accounting, and established life cycle assessment (LCA) methodologies. Emission factors are derived from a combination of peer-reviewed LCA datasets, national inventory reports, transportation and energy intensity datasets, and oracle-fed regional environmental data. All assumptions, system boundaries, and uncertainties are transparently documented and subject to periodic audits, ensuring that reported CO₂ reductions are scientifically robust, verifiable, and credible.

14. Risk Management

CarbonMove addresses potential risks across technical, regulatory, market, and adoption domains. Technical Risks include consensus manipulation, spoofing, and sensor vulnerabilities. These are mitigated through Proof of Commitment (PoC) consensus, validator slashing, machine-learning-driven fraud detection, and regular system audits. Regulatory Risks stem from evolving token classification and compliance requirements. Mitigation strategies involve legal review, utility-token structuring, and jurisdictional adaptability to ensure regulatory alignment. Market Risks, such as token price volatility, are managed through utility-driven demand, buyback programs, and a strategic treasury reserve. Adoption Risks, including challenges in user onboarding or sustained engagement, are addressed via gamification, strategic partnerships, and incentive mechanisms to encourage continuous participation. This multi-layered risk framework ensures resilience and long-term viability of both the platform and its climate impact objectives.

15. Privacy & Data Security

CarbonMove prioritizes user privacy and data security through multiple layers of protection. The platform leverages zero-knowledge proofs, on-device data preprocessing, irreversible hashing, and differential privacy where applicable, ensuring sensitive information remains confidential. Users maintain full control over their data through consent mechanisms, while regular security audits reinforce system integrity. Only anonymized proofs and aggregated environmental metrics are recorded on-chain; raw sensor data never leaves the user's device without robust cryptographic safeguards, maintaining both privacy and trust.

16. Impact Projections

By Year 4 End, CarbonMove anticipates significant growth and measurable environmental impact. Projections include over 2 million active global users, 500+ validator nodes, and 5 million verified daily eco-actions, resulting in an estimated 400,000 tons of CO₂ reduced annually. The platform expects more than 400 million CMT tokens to be in verified circulation. These outcomes are contingent on successful user adoption, strategic partnerships, and the maturation of supporting technologies.

17. Governance Framework

CarbonMove is governed by a decentralized autonomous organization (DAO) responsible for key platform decisions, including emission factor updates, protocol upgrades, validator policies, and ecosystem fund allocation. Governance mechanisms feature stake-weighted voting, quorum thresholds to ensure representative participation, and randomized arbitration panels for dispute resolution. All decisions are recorded on-chain, providing a transparent and auditable decision log that reinforces accountability and community trust.

18. Conclusion

CarbonMove envisions a world where sustainability becomes a verified, rewarded, and universally accessible form of climate contribution. By merging blockchain accountability with scientifically grounded CO₂ measurement, CarbonMove empowers individuals to participate directly in global decarbonization. Every verified step, trip, choice, or habit becomes an auditable environmental asset—proving that climate action at scale begins with Proof of Commitment. CarbonMove transforms ordinary behaviors into extraordinary collective impact.

