



SDG BLOCKCHAIN ACCELERATOR

MENTORSHIP FEEDBACK FORM

Team: Plastiks

Project Title: *Plastic Recovery Traceability & Tokenized Recycling Incentives*

Country Office: UNDP Armenia

Mentor: Ann Lu: ELabs Vietnam – Chief Technical Officer

Reporting Period: September–October 2025

Mentorship Type: Technical | Smart Contract Architecture | Deployment Strategy

Sessions Held: 2

1. Overview of the Prototype

The Plastiks team successfully developed and validated a prototype on the Cardano Pre-Production network, leveraging the Conway Era and its Plutus V2 enhancements, specifically reference scripts, inline datums, and stake-based certification. The PoC demonstrated tokenized recycling incentives through NFT issuance, plastic credit tracking, and multi-sig governed burn mechanics.

The technical stack comprises several core contracts, including:

- **NFTStoreFrontV4:** Lazy minting and listing of verified plastic recovery credits.
- **PlastikCryptoV2:** Signature verification and role-based identity validation.
- **PlastikBurner:** Token burning and supply management for credits post-verification.
- **PlastikNFTV4 / PlastikPRGV3:** NFT issuance and transfer with environmental metadata (CO₂ offset, volume, recovery data).
- **VerifiedAccounts / PlastikRoleV2:** RBAC system for accreditation of entities via multi-signature validation.
- **UtilsV2:** Shared helpers for policy ID checks, UTxO lookups, and script reference handling.

Off-chain services integrate Cardano wallet APIs (Nami, Eternl, Yoroi), Stripe payments, and external sustainability data feeds. The admin dashboard presents a unified interface for wallet management, recovery tracking, and issuance monitoring, simplifying operations for municipal and NGO actors.

2. Mentorship Objectives

The mentorship aimed to:

1. Review smart contract architecture for NFT issuance, burn, and accreditation flows.
2. Validate reference script integration and stake-based certification under Conway specifications.
3. Strengthen regulatory alignment with environmental authorities and Extended Producer Responsibility (EPR) frameworks.
4. Enhance API abstraction for external dashboards and offline adoption in rural settings.
5. Provide guidance on mainnet readiness, private IPFS gateway management, and security compliance.

3. Key Observations

- On-chain traceability was properly implemented. Each verified plastic recovery event produces an NFT containing structured metadata on IPFS, referencing verified CO₂ savings and geographic data.
- The use of stake-based certification adds a decentralized validation mechanism that supports SDG indicators 12 (Responsible Consumption), 13 (Climate Action), and 11 (Sustainable Cities).
- Multi-sig Role-Based Access Control (RBAC) was rigorously applied through *PlastikRoleV2*, preventing unauthorized token minting and ensuring verifiable governance actions.
- The offline-first design and API abstraction layer are technically sound, improving accessibility in areas with limited connectivity.
- Testing leveraged Ogmios/Kupo for transaction tracking and Blockfrost endpoints for explorer data.

Despite the complexity of multi-contract orchestration, the architecture demonstrates a cohesive, production-ready structure adaptable to municipal or NGO use cases.

4. Challenges and Technical Considerations

Category	Description
Scalability	Handling high-frequency issuance and burn events under multi-signature workflows increases validation overhead. Optimizations at the off-chain orchestrator level are recommended.
Rural Accessibility	Maintaining usability in regions with limited bandwidth requires efficient caching and retry logic within the dashboard.
IPFS Management	Transitioning from public to private IPFS gateways for mainnet deployment is mandatory for compliance and long-term data retention.
Auditability	The expanding contract suite necessitates an external audit, particularly around lazy minting, role enforcement, and NFT metadata validation.

5. Mentorship Interventions and Guidance

- Session 1 (September 2025) focused on Plutus V2 reference scripts, RBAC implementation, and off-chain orchestration.
ELV CTO guided the team in structuring contracts to reduce duplication, promote shared utilities, and standardize minting logic across NFT types.
- Session 2 (October 2025) emphasized audit-readiness and mainnet transition:
 - Defined clear policy separation between issuance, burn, and governance contracts.
 - Reviewed private IPFS gateway setup, recommending mirrored storage and periodic hash verification.

- Suggested metrics collection for CO₂ impact dashboards to align with UNDP sustainability reporting.

Mentorship also covered resilience testing (node recovery, transaction replay, and metadata consistency) and the integration of new waste type categories into NFT schemas.

6. Outcomes and Lessons Learned

- **Technical Robustness:** The modular contract design allows rapid onboarding of new partners and waste streams.
- **Governance Maturity:** Multi-sig RBAC provides a credible trust mechanism for NGO and municipal oversight.
- **Adoption Pathway:** API abstraction enables non-technical actors to interact with the system without blockchain knowledge.
- **Audit & Compliance:** On-chain anchoring combined with IPFS evidence hashes ensures traceability suitable for sustainability certifications.

7. Recommendations and Next Steps

1. **Contract Consolidation and Optimization** – Audit the overlapping utilities between NFTStoreFrontV4, PlastikPRGV3, and PlastikNFTV4 to minimize redundant logic.
2. **Security Audit** – Commission a formal smart contract audit covering lazy minting flows, multi-sig validation, and burn mechanics.
3. **Private IPFS Deployment** – Implement a closed gateway with redundancy and encrypted persistence layers.
4. **Expanded Data Feeds** – Integrate satellite and municipal data for automated validation of recovery activities.
5. **Impact Tracking Enhancements** – Incorporate community-level KPIs into the dashboard for stakeholder reporting.

8. Mentor's Reflections

Plastiks represents a strong example of how environmental accountability can coexist with decentralized architecture. Their multi-contract system is both modular and secure. The next critical milestone is ensuring compliance and resilience for mainnet, supported by a transparent auditing process and sustainable infrastructure.

9. Post-Accelerator Potential Support Pathways

Both parties agreed to continue collaboration post-accelerator, focusing on:

- Mainnet deployment support and IPFS gateway hardening.
- Security audit preparation and contract performance benchmarking.
- Expansion of accredited recycling partners under UNDP supervision.
- Integration of stable payment mechanisms and impact certification tokens.