Progress Report: Cohort 1 Teams

#	Project Name	UNDP Challenge	Technical Progress	Smart Contracts / API Usage	Dashboard / Frontend Status	UTxO / Blockchain Notes	Regulatory / Compliance Notes	Key Challenges	Lessons Learned	Next Steps / Recommendations	Tech Support / Feedback
1	*Thallo*	Inclusive climate finance & tokenized carbon credits - UNDP Tanzania	Thallo, already operating as a carbon credit tokenization platform on EVM chains (Ethereum and Polygon), developed a functional proof-of-concept (PoC) on Cardano. The PoC demonstrated token issuance, transfer, and retirement flows aligned with emerging carbon registry standards. The objective was to establish a foundation for a national carbon registry for Tanzania, built on Cardano's extended UTxO (EUTxO) model for greater transparency and traceability. The system successfully simulated carbon credit creation, transfer between stakeholders, and retirement events linked to verifiable project data.	The team leveraged Nexchange APIs provided by Emurgo Labs to handle key tokenization workflows such as minting, buy/sell orders, and retirement. These APIs were deployed on Thallo' s own infrastructure to maintain operational flexibility. Additionally, the Aiken smart contract templates developed by Emurgo were customized to suit Thallo's specific token schema and transaction flows. A hybrid off-chain registry linkage was implemented to satisfy regulatory constraints, as the Tanzanian framework for environmental asset registries is still under development. The team extended the Nexchange functionality by building an additional "Retirement" endpoint, connecting each retired token to off-chain project documentation and verifier signatures stored in a secure metadata layer.	The dashboard MVP displays real-time project data, issued and retired tokens, and transaction histories, along with downloadable audit logs. It also allows administrators to view registry-level summaries and project developers to initiate new issuance requests. The interface design followed Thallo's existing EVM frontend to minimize user onboarding friction while incorporating Cardano-based project data through API calls. A future iteration will include a multi-chain explorer view, enabling cross-network visibility of carbon credit provenance and status across both EVM and Cardano environments.	Implementing the PoC on Cardano presented challenges related to the EUTxO transaction model, particularly with batch processing and multi-party updates. To mitigate this, the team adopted a hybrid off-chain computation model, where key registry state changes (such as verifier approvals and regulatory sign-offs) occur off-chain but are anchored to Cardano via metadata and API calls. This design ensured compliance while retaining blockchain-based auditability. Future work will involve refactoring smart contracts for full Cardano-native operation once the regulatory registry is formally recognized.	Thallo engaged early with Tanzania's environmental and regulatory agencies, including the Ministry of Environment and the Tanzania Forest Service, to align the registry structure with national carbon standards. The UNDP country office is assisting with coordination and policy alignment to define the compliance requirements for tokenized credits under Tanzanian law. The evolving regulatory landscape necessitated an off-chain bridge model for now, but the engagement laid the groundwork for future on-chain registry implementation once national frameworks mature.	Limited Cardano-native expertise; batch transaction handling; multi-stakeholder coordination We have provided the team with technical support especially when it comes to refactoring some aspects of the Nexchange contracts The team had to add "Retirement" feature and linking with the offchain registry which was not provided with the nexchange API	The PoC validated that hybrid architectures can serve as effective interim solutions when regulatory clarity is pending. The mentoring and hands-on technical support from Emurgo Labs accelerated the team's understanding of Cardano's UTxO transaction semantics, metadata design, and off-chain API orchestration. Early regulatory engagement prevented potential misalignment with national requirements and ensured smoother integration planning for a future full-scale registry.	- Transition from hybrid APIs to fully Cardano-native smart contracts using Aiken once regulatory clearance is obtained. - Optimize batch transaction logic for issuance and retirement events under EUTxO constraints. - Expand analytics and reporting modules for project-level carbon impact measurement. - Continue collaboration with the UNDP and Tanzanian agencies to formalize the carbon registry framework. - Develop a multi-chain monitoring dashboard to unify EVM and Cardano tokenized asset data.	We provided one-on-one mentoring on UTxO-based modeling, contract refactoring, and API integration. The team received iterative guidance on metadata design, hybrid architecture choices, and contract testing workflows. Support also included reviewing their off-chain registry bridge logic and ensuring compliance with Cardano transaction constraints. Continued collaboration is expected through the next phase as Thallo transitions toward a production-ready Cardano-native implementation.
2	*Socious Fund*	Transparent crowdfunding for solar energy access - UNDP Mauritius & Seychelles	MVP built; tracked crowdfunding pledges and disbursement flows through a whitelabeled solution of the socious platform dedicated to the UNDP country office	The team is already cardano native and have a working product The country office wanted to extend the crowdfunding to use Stabelecoins such as USDM and USDA Socious has decided to put this for the next stage, especially with USDA due to the limited liquidity and retail access	The whitelabeled dashboard offers a fully functional front-end interface with modules for campaign management, donor verification, contribution tracking, and payout visualization. Administrators can monitor total raised funds, track disbursements, and view verified donor data. Donors can browse live projects, contribute via supported tokens or fiat onramps, and receive proof of participation through digital certificates. The front-end was customized for the UNDP Mauritius and Seychelles offices, allowing for localized branding and administrative controls. The platform also supports multi-role access, real-time analytics, and transparent audit trails for all donations and project expenditures.	The team has not yet deployed UTxO-based crowdfunding logic, as the MVP focused primarily on integrating the Socious architecture with UNDP operational systems. Planned upgrades will utilize Cardano's EUTxO model for stablecoin-based contributions and milestone tracking once USDA and USDM gain sufficient liquidity and accessibility. The backend already contains the necessary modules to integrate these stablecoins seamlessly once network and compliance conditions are met.	Coordinated with Mauritius & Seychelles regulatory offices; compliance checks on fundraising rules The country office has been working with the central bank and regulatory tax othorities to understand the impact of using crypto currencies as donations Emurgo labs has helped with linking the project with Encryptus to offramp the funds raised into local fiat currency	The primary challenge was ensuring that the UNDP country office, which is not blockchain-native, could confidently manage parts of the whitelabeled infrastructure, including wallet custody, transaction monitoring, and KYC approvals. Off-ramping and stablecoin integration introduced additional complexity, requiring both regulatory guidance and technical mentorship.	The team learned that institutional adoption of blockchain-based crowdfunding requires not only technical readiness but also capacity-building on the part of non-technical stakeholders. Providing clear operational manuals, simplified wallet management processes, and regulatory coordination proved essential for institutional acceptance. The whitelabel model also showed that decentralized infrastructure can coexist effectively with centralized administrative oversight when governance frameworks are well-defined.	- Extend the platform to support multi-project crowdfunding with independent milestones and payout automation. - Implement USDA and USDM stablecoin support for donor contributions once sufficient on-chain liquidity becomes available. - Develop training and documentation modules for UNDP staff to manage wallets, KYC processes, and transaction oversight. - Integrate a fiat off-ramp workflow with Encryptus APIs for seamless disbursement into local bank accounts. - Evaluate the inclusion of impact-tracking NFTs or verifiable receipts for donors.	Mentorship focused on regulatory coordination, off-ramp integration, and infrastructure governance. The Emurgo Labs team supported Socious in exploring Encryptus integration, advising on Cardano stablecoin readiness, and assisting the UNDP office in developing internal operational guidelines for handling crypto assets securely. Further mentorship is planned around stablecoin payment architecture and compliance monitoring as the project scales.
3	*Atlas Ledger*	Traceable donor-backed reforestation systems - UNDP Burkina Faso	Completed a full end-to-end proof-of-concept (PoC) for a donor-backed reforestation tracking platform on the Cardano blockchain. The PoC demonstrates how verified reforestation projects can receive milestone-based funding directly from donors, with transparent on-chain records of disbursements and project progress. The system integrates a Next.js 15 frontend, a NestJS backend, and a suite of Aiken V6 milestone validators. It supports complete user management, project administration, milestone control, and on-chain transaction tracking. All comprehensive endpoints are tested successfully on the Cardano Preprod Testnet, with multi-donor and multi-milestone contract executions validated.	developed a suite of Aiken-based milestone validators (V6 series) to manage conditional payouts to reforestation projects. Each validator enforces strict rules around milestone indices, verified admin signatures, and beneficiary verification. Contracts are fully Plutus v3–compatible, compiled using Aiken CLI v1.1.19, and tested through both unit tests (aiken check) and integration tests executed directly on the Preprod network. The backend uses Local Evolution (v0.4.29) for transaction building and submission, with full support for complete contract creation, contract deployment, and payout orchestration. The API layer includes comprehensive endpoints for wallet management, user and KYC handling, project creation, and smart contract operations. The system has demonstrated reliable end-to-end contract execution, including multi-input, multi-output, and milestone-gated transactions.	Admin Dashboard: Full administrative control panel with extensive management capabilities: ○ User Management: Complete user oversight with KYC approval/rejection, wallet creation, and role assignment ○ Project Administration: Review and approve/reject climate projects, manage project statuses and milestones ○ Smart Contract Operations: Deploy and monitor V6 milestone-based contracts, view all deployed contracts with status tracking ○ Financial Management: Treasury wallet management, fund user wallets, track all transactions with real-time Cardano blockchain status ○ Transaction Monitoring: Complete transaction history with Preprod testnet explorer integration and automatic status synchronization ○ Milestone Control: Trigger milestone payouts, reset projects for testing, manage milestone progression ○ System Health: Monitor platform health, donation simulation status, and blockchain connectivity ○ Wallet Operations: Create donor/project owner wallets, check live balances, fund wallets from treasury	UTxO scalability challenges during the batch minting and payout process for transactions involving multiple donors. The V6 validator scans the full transaction body for each donor UTxO, causing CPU and memory utilization to grow quadratically with donor count. Despite this, all integration tests on the Preprod testnet passed validator checks and returned consistent execution costs across milestones. The team mitigated performance bottlenecks by introducing off-chain mapping and donor batching strategies (up to 20 donors per transaction) and by applying pre-flight transaction cost estimation to prevent script overflows. The backend architecture supports future optimization through UTxO consolidation and redeemer-branching logic for multi-donor scenarios.	engaged directly with Burkina Faso's environmental authorities to align donor-backed reforestation tracking with local regulatory frameworks. KYC and donor verification modules were implemented in compliance with UNDP and local requirements. Donor onboarding and contribution verification workflows were fully integrated into the admin dashboard.	rimary technical challenge lies in scaling multi-donor transactions within Cardano's per-transaction resource limits. Each additional donor UTxO increases validation cost, which risks exceeding CPU/memory thresholds during large-scale deployments. The team also identified cross-donor reporting complexity as a secondary challenge, requiring synchronized off-chain state management.	The team confirmed that combining off-chain data handling with on-chain milestone validation significantly improves performance and system reliability. Hybrid architectures allow for maintaining on-chain transparency without overloading validator logic. Iterative testing on Preprod helped validate validator correctness, identify cost bottlenecks early, and refine contract parameterization. The project also demonstrated the importance of modular API design for integrating blockchain operations with user-facing dashboards	- Implement an on-chain consolidation mechanism to merge multiple donor UTxOs before payout. · Conduct a security audit of the V6 contract series and prepare for a V7 upgrade with multi-signature admin validation. · Integrate remote sensing and AI-based project verification tools to automate impact validation. · Extend the dashboard with AI-guided project creation assistance, automated project text generation, and advanced analytics. · Optimize database and caching layers for scalability in mainnet conditions.	Guidance was provided on Lucid integration, pre-flight transaction cost estimation, and off-chain orchestration best practices. Mentors also supported documentation refinement and mainnet-readiness planning, ensuring the team's progress aligns with production deployment standards.
4	*Genius Tags (ClimateAid)*	Predictive humanitarian aid delivery - UNDP Malawi	Genius Tags delivered a functional PoC for predictive humanitarian aid distribution. The platform enables organizations to track aid allocation, manage beneficiaries, and generate predictive alerts for resource allocation in remote regions. The system combines decentralized ledger technology with predictive analytics to optimize aid delivery, while ensuring transparent and verifiable reporting. Beneficiary deduplication and unique ID management are integrated to prevent duplication and ensure accountability	Smart contracts manage aid credit issuance, transfers, and redemption, while predictive alerts are computed off-chain to minimize computational overhead on Cardano. Metadata associated with each transaction provides a verifiable audit trail, linking distributed aid to unique beneficiaries. REST APIs act as a bridge between off-chain predictive models and on-chain tokenized aid.	The dashboard visualizes distributed resources, predicted aid needs, and beneficiary status. It supports multiple user roles (admin, field officer, donor) and provides real-time analytics on aid distribution performance. Users can query transaction histories, monitor tokenized credits, and export data for compliance and reporting. A mobile-friendly interface ensures that field teams can access critical updates even in low-connectivity environments	Due to limited Cardano-native development resources, the team implemented a hybrid on-chain/off-chain architecture. On-chain components handle aid credit and immutable audit records, while predictive algorithms and resource allocation models operate off-chain.	The project coordinated with UNDP Malawi and local authorities to align on data reporting standards and regulatory compliance. Collected data from remote regions were validated against existing humanitarian reporting frameworks, ensuring alignment with national and international reporting obligations.	Challenges included remote data collection, ensuring predictive model accuracy, and bridging the gap between off-chain analytics and on-chain tokenization. Additionally, limited availability of Cardano-native developers necessitated a hybrid approach, balancing rapid PoC deployment with technical rigor.	The hybrid approach demonstrated that off-chain predictive logic can be safely integrated with on-chain tokenization to accelerate deployment without compromising auditability. Mentoring and technical support enabled the team to quickly adapt Plutus templates for their use case and integrate Nexchange APIs effectively.	- Integrate real-time data feeds to improve predictive accuracy for aid distribution. - Expand on-chain functionality as Cardano expertise grows, reducing reliance on off-chain computation. - Implement comprehensive testing for predictive models and tokenized aid transactions. - Prepare for mainnet deployment with security audits and optimized transaction flows. - Enhance dashboard visualizations to support multi-region predictive reporting and performance analytics.	Support included guidance on hybrid architecture design, beneficiary UID verification, and audit log generation. Iterative feedback helped the team refine transaction workflows, improve metadata design, and integrate predictive analytics effectively.
5	*Grinplus*	Electricity losses, billing transparency, and renewable energy integration - UNDP Tanzania	Delivered a functional PoC addressing TANESCO' s electricity losses using blockchain-backed energy consumption tracking. The system records electricity usage from smart meters or mobile billing endpoints and securely stores readings on the Cardano testnet. The PoC demonstrates tokenization of consumption readings, enabling immutable audit trails for consumption data and reducing opportunities for fraud and manipulation.	The PoC leverages Cardano testnet transactions via PyCardano for constructing, signing, and submitting transactions. The Blockfrost API is used as a blockchain interface for transaction queries and submission. Wallet operations and tokenization are handled via scripts orchestrated via Python scripts, providing a lightweight CLI for energy data submission and validation. No automated smart contract testing implemented yet; tokenization logic executed through off-chain scripts.	Frontend built with React displays energy consumption data, tokenized readings, and wallet balances. Dashboard functionality includes basic data visualization, consumer overview, and tokenization reporting. The interface allows utility administrators to review and audit electricity readings in near real-time and track tokenized consumption flows.	Hybrid architecture: on-chain tokenization for energy readings ensures immutability; off-chain aggregation used for analysis and visualization. Transactions are submitted in a UTXO model via PyCardano scripts. Testnet wallets were used for PoC deployment and validation; no automated scaling tested yet.	Coordinated with UNDP Tanzania and utility operators to ensure compliance with electricity reporting standards and data handling regulations. Regulatory focus includes accurate metering, auditability, and alignment with national electricity sector policies	Key challenges include integrating real-time data streams from smart meters, mapping distributed energy readings to tokenized UTXOs, and handling the hybrid off-chain/on-chain data model. Additionally, limited mainnet deployment experience constrained stress-testing under realistic network conditions.	The PoC demonstrated that Python-driven tokenization scripts coupled with Blockfrost/Cardano testnet provide a rapid development path for electricity consumption tracking. Insights from integration with legacy billing systems highlighted the importance of careful data modeling, timestamp synchronization, and validation of tokenized readings.	- Integrate generation data alongside consumption readings to build a full energy flow model. · Expand PoC to additional consumer categories for broader validation. · Implement automated smart contract testing and deployment pipeline. · Enhance dashboard with predictive analytics to identify losses and inefficiencies.	Mentorship focused on Cardano transaction construction, PyCardano integration, and UTXO modeling. Guidance included data modeling for electricity readings, tokenization workflows, and strategies for expanding PoC to full-scale deployment. Provided recommendations for off-chain aggregation, visualization best practices, and regulatory alignment with utility operators.
6	*Karbon Ledger*	CETP Compliance & Climate Credits - UNDP India	Delivered a working PoC implementing real-time compliance and climate accounting for CETPs. Sensor data from treatment plants is validated (via AI) and anchored on-chain. The system manages the lifecycle of Carbon Emission Tokens (CETs) and Carbon Offset Tokens (COTs).	Aiken smart contracts manage minting, burning, and token lifecycle events. Contracts include project validator, marketplace, and crowdfunding logic. Transactions monitored via Blockfrost API webhooks, integrated with Supabase to update token tables in real-time. Edge cases like token quantity mismatch and missing signatures were handled.	Next.js dashboard displays project submissions, validator votes, token lifecycle status, and SDG-aligned metrics. Operators and regulators can track compliance, review audit logs, and generate reports. Supabase backend supports RBAC and policy enforcement.	Cardano Preview Testnet used; UTXO-based model ensures immutability of CETP data. Token lifecycle events (mint, transfer, burn) are captured via webhooks and reflected in Supabase. Multiple validators deployed sequentially for project approval workflows.	Aligned with UNDP India and SPCB requirements. Compliance focuses on wastewater treatment metrics (COD, BOD, TDS, pH) and traceable carbon emissions. Public and operator-facing reporting supports regulatory transparency.	Key challenges include IoT integration for live sensor data, optimizing Aiken contracts to reduce execution units, and preparing for Preprod/mainnet deployment. Hybrid off-chain/on-chain architecture requires careful reconciliation to prevent inconsistencies.	PoC validates that Cardano-native contracts plus off-chain services (Supabase + Next.js) can provide reliable, auditable compliance records. Early stakeholder engagement ensures usability and regulatory alignment. Blockfrost webhooks are effective for real-time monitoring, though hybrid architecture requires robust reconciliation scripts.	- Integrate IoT sensor streams into Supabase and link to on-chain token logic. · Optimize Aiken validators for gas/transaction efficiency. · Implement DAO governance module for SPCB/community oversight. · Transition to Cardano Preprod for larger-scale stress testing · Expand automated testing for validator workflows, crowdfunding, and marketplace flows. · Enhance dashboard for predictive analytics and real-time compliance reporting.	Mentoring focused on UTxO modeling, Aiken smart contract design, token lifecycle management, and off-chain integration with Supabase. Guidance provided for IoT integration planning, security considerations, and SDG metadata embedding. Recommended stress testing and scalability preparation for mainnet deployment.
7	*Afrikabal*	Supply chain traceability for climate-friendly farming - UNDP Malaysia	PoC completed successfully on Cardano Preview; deterministic transaction pipeline validated, native token minting and burning tested (AFRIKABALPROOF). Build reproducibility confirmed; transaction submission and confirmations ≥96–100% success. Preview network used for full lifecycle tests including pay-to-self, mint, and burn.	Smart Contracts: Aiken-based Escrow and Attestation validators. Escrow locks buyer funds, releases to producer/cooperative after proof-of-delivery, or refunds on timeout/dispute. Attestation validator controls supply-chain actions with evidence CIDs & checksums. Off-chain Orchestrator: Lucid TS scripts manage transaction build, signing, submission; enforces sequencing, policy, retries via job queue. APIs: Blockfrost Preview endpoints for chain interactions; indexer for UTxO/balance queries.	Web/Mobile: Buyer & logistics interfaces functional. Mobile & USSD: Farmers can transact via USSD (OTP-based session), or mobile app. Dashboards: Prepod dashboards display transaction confirmations, escrow status, evidence metrics. Planned production dashboards include KPIs, SLOs, and impact metrics.	UTxO & Token Lifecycle: Pay-to-self transactions, minting & burning of AFRIKABALPROOF confirmed. Escrow state tracked as single UTxO per order; datum holds hashes only; evidence pinned off-chain to IPFS. Reference Inputs supply oracle facts and role badges. Minimal on-chain footprint ensures auditability and reduces storage cost.	Regulatory: KYC/onboarding procedures planned for pilot geographies; escrow-like flows ensure accountability. No PII stored on-chain. Compliance with transaction transparency, auditability, and evidence retention. Regulatory review in progress for local pilot.	Key Challenges: Farmer onboarding via USSD; multi-role coordination (buyers, farmers, logistics, cooperatives); ensuring deterministic transaction flows; managing off-chain/on-chain reconciliation; fallback provider path needed, mint/burn policy validation; evidence completeness; high-volume orchestration under provider limits.	Lessons Learned: Deterministic builds critical for reproducibility. Off-chain/on-chain reconciliation ensures data integrity. Role-based access and "present-and-return" token semantics work as intended. Multi-channel integration feasible but requires careful session/key management. Fallback provider paths are essential for resilience.	Integrate buyer/producer flows fully (escrow + attestations). Prepod dry-run with realistic load, HA validation, and provider failover tests. Build SLO dashboards. Mainnet hardening (fees, retries, policy review). Partner onboarding wave 1 (buyers, co-ops, farmers) with ≤1 day lead time. Payments & settlement flows live (escrow release). Deploy impact analytics v1 (gender/region, evidence completeness).	Provided guidance for environment setup (.env), Aiken build/check, Lucid integration, transaction submission, mint/burn flow, UTxO verification, and preview network provider setup. Feedback loop confirmed deterministic pipeline and reproducible TX hashes.
8	*Cladfy*	Blockchain-Enabled CRF Fund Disbursement System - UNDP Bangladesh	Prototype PoC completed on Cardano Preprod. Hybrid cooperative loan management platform validated for onboarding, repayments, disbursing loans, and logging repayments. DID registration, loan creation, and transaction submission successfully tested end-to-end. Flask backend orchestrates loan lifecycle. Preprod network used for full lifecycle tests; transaction success rate ≥95%.	Conceptual Plutus validators per loan (Aiken-based). Validators handle loan disbursement, repayment, and committee approval. Datum stores Borrower DID, Loan ID, principal/interest. Redeemer handles actions: Disburse/Repay. APIs: Flask endpoints for member/loan management; Blockfrost Python SDK for transaction submission and monitoring; pycardano for UTxO handling and metadata creation.	Tailwind + JS dashboard shows members, loans, transactions, and contract statuses. Frontend: Beneficiary web app accessible via https: //logic-crf.cladfy.app . Features include DID registration, loan submission, loan status tracking, repayment history. Mobile money integration via backend simulation.	Transactions follow UTxO model. Cooperative wallet signs disbursement and repayment UTxOs. Metadata links each transaction to loan ID & DID. Conceptual Plutus contracts used for each loan. No native tokens yet (future phase: cooperative tokens). Transaction confirmation times ~30–45s on Prepod.	Off-chain cooperative dashboard reconciles with on-chain transactions. DID system ensures privacy. Multi-cooperative support planned. Phase 2 includes governance/DAO voting, HSM/multi-sig for key security. Compliance with local financial oversight considered; sensitive data not stored on-chain.	Off-chain/on-chain reconciliation; multi-cooperative registry; committee participation; loan defaults; scaling throughput; ensuring reliable mobile money integration; fallback infrastructure for network downtime; secure key management for cooperative wallet.	Hybrid model with off-chain dashboards + on-chain transparency is feasible. Deterministic transaction construction ensures reproducibility. DID-based identity simplifies borrower onboarding. Flask + pycardano + Blockfrost provides reliable Preprod integration.	Move from in-memory → PostgreSQL. Implement multi-cooperative registry. Improve contract validators. Add DAO-style governance and voting. Security audit (HSM, multi-sig). Benchmark disbursement throughput and latency. Integrate fully with national mobile money platforms	Guidance on environment setup, Flask backend, pycardano integration, UTxO construction, Blockfrost API usage, Plutus contract simulation, DID registration, mobile money integration mock-ups.
9	*ZenGate Global (Palmyra Pro)*	Blockchain traceability in agriculture & public procurement - UNDP Bangladesh	Prototype PoC completed on Cardano Preprod. Plug-and-play blockchain gateway for traceability platforms tested with SERA. JSON events. Backend handles IPFS pinning, transaction orchestration, and indexing. End-to-end tests for singleton minting, recreate/update, and spend operations completed successfully.	Aiken-based Plutus V2 validators. Singleton Minting Policy ensures uniqueness. Object Event Validator manages stateful UTxO lifecycle. APIs: Winter-Backend exposes REST endpoints for create/recreate/spend events. Integrates with IPFS and Cardano node. Library supports transaction building, signing, submission. Redeemers enforce action rules.	Demo UI / explorer for monitoring UTxO states, singleton lifecycle, and traceability event confirmations. Off-chain metrics stored in Postgres + Redis queues. Frontend provides integration for traceability platforms (SERA) with JSON submission and transaction feedback.	Singleton NFT per object, locked in object_event validator UTxO. Create, Recreate, and Spend transactions validated by smart contracts. Data_reference links off-chain JSON (IPFS CID). Lovelace preserved or increased per validator rules. Transactions logged and indexed via Ogmios/Kupo	On-chain anchoring provides independent verification for regulators and buyers. Ensures data integrity across traceability platforms. Compliance relies on correct IPFS storage and validated transaction hashes. Multi-chain support planned in future.	Integration with legacy cloud-first systems (SERA), ensuring API reliability, preventing double-counting, maintaining singleton integrity, handling retries/failures in backend orchestration, network latency.	Abstracting blockchain complexity via APIs + library makes traceability platforms blockchain-ready without direct key management. Singleton NFT pattern prevents duplication. Integration of IPFS for off-chain metadata simplifies validation	Upgrade Winter Protocol v2 (multi-chain), implement private IPFS gateways, add Winter Auth for credential verification, expand adoption to other platforms beyond SERA, monitor transaction reliability, plan mainnet deployment.	Guidance on environment setup (Cardano node, Aiken compiler, Blockfrost), Winter-Backend orchestration, Redis queue handling, Postgres integration, IPFS pinning, validator redeemer structure, transaction monitoring
10	*Creative Operations*	Reloop: Incentivized e-waste collection via token rewards - UNDP Georgia	MVP tracks e-waste collection and token issuance. Major technical milestones achieved in Q3–Q4 2025. Aiken validator scripts for the RELOOP Treasury successfully deployed and tested on the Cardano Preview Testnet. The validator now supports all seven operational actions (SubmitDrop, ClaimReward, RegisterWallet, RegisterBrand, CreateVault, SubmitProof, and Withdraw). Backend API integration with Supabase completed; synchronization with Firebase and Blockfrost APIs achieved stable throughput of ~1200 API calls/hour. Continuous integration pipelines implemented through GitHub Actions for auto-build and testnet deployment. Backend database structure optimized for analytics (35% faster query response). System load testing achieved sustained performance with up to 1,000 simulated user actions per minute, maintaining <2.3s API latency.	The reloop_treasury validator functions as a universal state machine managing e-waste submissions, tokenized rewards, and proof-of-collection claims. Implemented with modular Aiken design for maintainability and efficiency. API Integrations: Ogmios and Kupo used for UTxO tracking and on-chain event streaming; Blockfrost and Firebase ensure redundancy and automation. Integration with IPFS ensures all photographic proofs (before/after disposal) are hashed and verified on-chain. Emulator & Testnet Results: Internal testing achieved 98% validator pass rate; gas efficiency improved by 40% compared to first prototype; memory footprint reduced from 1.2MB → 730KB. Smart contract now supports batch reward distribution up to 50 users per transaction, reducing operational cost per user by 72%.	RELOOP's dashboard built in Next.js 15 and React 19, integrated with Supabase for authentication and data sync. The web dashboard enables live tracking of user activity, CO_2 offset estimates, and reward distributions. Data visualizations implemented with Grafana and Chart.js for monitoring KPIs in real time (number of drops, verified submissions, total ADA distributed, and e-waste weight processed). Mobile app prototype (React Native) successfully tested for GPS-based drop verification, QR-code scanning, and real-time submission updates. Performance optimized with lazy-loading and client-side caching, improving perceived load time by ~60%. Admin panel includes audit logs and manual override tools for validators in case of API downtime.	All state transitions occur via UTxO-based architecture, ensuring transparency and traceability. Each drop or user registration is represented by a unique UTxO; treasury transactions leverage BatchDatum for collective reward settlements. System designed to be fully auditable, with immutable metadata pointers linking to off-chain proofs. Preliminary designs for on-chain CO_2 offset certification using metadata hashes have been validated. Multi-sig configuration under testing (3-of-5 scheme) for treasury operations to meet UNDP financial security standards. Work ongoing to implement rate-limited treasury withdrawals with automated proof-of-claim verification.	Georgian environmental agency consulted Partnership with Wastiless: Local Ewaste agency to review Data minimization & consent protocols Token Distribution is under ongoing legal review; compliant with UNDP crypto asset policies.	• Script memory optimization to reduce <800 KB per tx. • API rate-limiting delays from Blockfrost. • Treasury multisig setup pending. • Minor frontend load delays under high concurrency.	Aiken's modular design dramatically improved iteration speed; abstracting logic from redeemer actions simplified testing. Batch processing model reduced overall gas consumption by ~70%. Early integration of Supabase allowed rapid backend scalability. Real-time telemetry via Grafana revealed transaction bottlenecks that would have been missed through manual testing. The iterative deployment model (dev → preview → preprod) provided critical safety. Stakeholder onboarding showed importance of UX clarity: users responded better to simplified submission flows than to reward dashboards.	Complete full load testing on Cardano Preprod (target 60 TPS). Deploy multi-sig treasury wallet and finalize audit scripts. Begin integration of Fireblocks for cross-network treasury rebalancing. Conduct formal smart contract audit (January). Deploy CO_2 impact oracle (in partnership with local verifiers). Launch production mainnet release in Georgia, followed by phased expansion to 10+ cities across Eastern Europe.	Guidance was given on Aiken optimization and UTxO model refinement. Request continued technical support for Fireblocks and Ogmios API optimization. Additional documentation/templates requested for quarterly compliance reporting and treasury governance monitoring. Need clarification on recommended methods for integrating ESG data oracles with RELOOP dashboards. Plans to collaborate with other UNDP cohorts on circular economy tokenization strategies.
11	*Plastiks*	Plastic recovery traceability & tokenized recycling incentives - UNDP Armenia	Prototype (PoC) completed on Cardano Pre-Prod. Conway Era leveraged for Plutus V2 enhancements, reference scripts, inline datums, and stake-based certification. Tested NFT-based plastic credit issuance, token burning, and multi-sig governance workflows.	Core contracts include NFTStoreFrontV4 (lazy minting), PlastikCryptoV2 (signature verification), PlastikBurner (token burning), PlastikNFTV4 (NFT issuance/transfer), PlastikPRDV3 (environmental impact NFTs), VerifiedAccounts (KYC verification), PlastikRoleV2 (multi-sig RBAC), UtilsV2 (helper functions). APIs integrate Cardano wallets (Nami, Eternl, Yoroi), Stripe payments, blockchain explorer endpoints, and sustainability data feeds.	Admin dashboard provides real-time tracking of token issuance, accreditation, wallet creation, and recovery data. Off-chain metrics logged weekly; dashboards support municipal and community engagement reporting.	NFTs issued per verified recovery event; each NFT contains structured IPFS metadata with plastic recovery and CO_2 savings info. Transactions anchored to Cardano, tracked via Ogmios/Kupo, following EUTxO model. Minting, transfer, burn, and role-management transactions validated by Plutus V2 scripts.	Armenian environmental and recycling authorities consulted. Compliant with SDG 12, 13, 11 indicators. Data integrity ensured through on-chain anchoring, IPFS metadata, and verification of accredited entities. Stake-based certification used for decentralized validation of recovery projects.	Tracking multiple token types and recycling events in addition to reconciling off-chain vs on-chain data, onboarding rural users with limited digital literacy, connectivity issues, integration with municipal actors, and ensuring regulatory alignment with EPR policies.	Abstraction of blockchain operations via APIs and dashboards simplifies adoption. Multi-signature RBAC prevents unauthorized actions. Offline-first design enables rural user participation. IPFS-based metadata ensures transparency and auditability. Also when using IPFS, a private gateway is mandatory for mainnet deployment	Next steps include redesigning credit creation forms and NFT visuals, expanding accredited entities, adding new waste types and metrics, continued monitoring of CO_2 avoidance, and scaling community engagement. Maintain mainnet stability and update smart contracts if needed.	Guidance provided on Cardano node setup, Plutus compilation, testnet validation, mint/burn workflows, API integrations, and dashboard analytics. Support also includes handling offline-first operations and rollback procedures.

#	Project Name	UNDP Challenge	Technical Progress	Smart Contracts / API Usage	Dashboard / Frontend Status	UTxO / Blockchain Notes	Regulatory / Compliance Notes	Key Challenges	Lessons Learned	Next Steps / Recommendations	Tech Support / Feedback
12	***IotaOrigin UG / BlackFrog***	Mineral Supply traceability - UNDP Istanbul	PoC demonstrates tokenized RWA crowdfunding for critical raw materials. Users can contribute ADA, claim refunds if targets not met, and admin can withdraw funds upon campaign success. Node.js off-chain scripts manage contributions, refunds, and withdrawals.	Aiken Plutus V3 Validator: handles contribution validation, refund logic, and owner withdrawals. Datum Structure: owner PKH, start/end dates, interest rate, target amount, currentRaised, contributors list. Redeemer Structure: Contribute (pkh, amount, timestamp), Refund(pkh), Withdraw(). Node.js Scripts: 1-initialize.js, 2-contribute.js, 3-refund.js, 4-withdraw.js, utils.js. Future integration: RWA token minting/burning, stablecoin contributions, price oracles.	Basic dashboard shows transaction history, contribution amounts, and fund status. Frontend currently lacks full claim/burn workflow for RWA tokens. Video demo illustrates user contribution and withdrawal flows. Dashboard integrates off-chain script outputs for real-time updates. Future frontend will include investor-specific token balances and interaction with mint/burn RWA tokens	Contract state stored as inline datum, each contribution consumes and updates datum UTxO. Refunds and withdrawals consume UTxOs and release funds. Script execution verified with sandbox/testnet. Transaction Lifecycle: Initialize → Contribute → Refund/Withdraw → Off-chain update. Successful deployment validated on Cardano Preprod testnet with CPU/memory logs.	Istanbul regulatory office consulted for conflict minerals compliance Compliance review ongoing for tokenized investment instruments. PoC aligns with ESG/ESG-aligned financing standards. Future work includes auditing smart contracts, validating RWA token issuance under financial regulations, and ensuring EU Taxonomy compliance.	Integration of off-chain scripts with UTxO-based contracts is complex; requires careful state tracking to avoid double-spends. Stablecoin adoption introduces oracle dependencies. Frontend RWA token claim/burn functionality needs secure wallet integration.	Clear separation of on-chain vs off-chain operations prevents UTxO state conflicts. Validator optimization significantly reduces execution units. Edge cases (late contributions, over-contributions, early withdrawals) must be explicitly tested.	1. Add unit tests for all validators. 2. Optimize validator execution to reduce script costs. 3. Deploy RWA token minting and burning policy. 4. Switch contributions to stablecoins with price oracles. 5. Implement frontend claim/burn flow. 6. Perform stress and edge-case testing on Preprod before Mainnet deployment. 7. Security audit of validators and off-chain scripts. 8. Integration with regulatory reporting and ESG verification pipelines.	Technical support includes Lucid Evolution scripting guidance, Aiken CLI setup, Blockfrost API integration, and testnet funding instructions. Feedback loops from testing highlight contribution validation edge cases and UTxO lifecycle management.
13	***Unicorn.eth***	Crowdfunded microgrids - UNDP Nordic Representation Office	Wallet connection fully integrated with ADA and token donation flows; BigInt/decimal conversion issues resolved; multi-network testing completed (preprod & mainnet); donation transaction history implemented	Uses @meshsdk/react and @meshsdk/core to construct, sign, and submit transactions; optional GraphQL donation recording; tested both ADA-only and token + ADA combos; transaction retries implemented for network congestion	Next.js 14 frontend with donation forms, USD conversion display, min-ADA checks; responsive layout for mobile & desktop; error handling and user notifications implemented Not so many changes to the UI since the team is using their crowdfunding solution Giveth	Min-ADA enforced for all token transfers; ADA top-up prompt added for insufficient balances; UTxO management handled to prevent double spending; transaction verification implemented via preprod and mainnet	Nordic regulatory guidance consulted for crowdfunding and energy compliance No regulatory blockers identified; UNDP compliance reviewed; anonymous donations permitted but on-chain data is transparent; KYC/AML not required, but audit trail considered	Multi-wallet support caused edge cases with pre-signed UTxOs; decimal and BigInt conversion errors; network mismatch errors; user confusion on min-ADA top-up	Pre-checks for ADA/token balances reduce failed transactions; normalizeAmount() and toUnits() utilities critical for reliable token handling; frontend error messaging improved UX	Optimize transaction fee estimation to reduce failed payments; refine donation UX for first-time users; extend coverage for additional wallets; implement automated testing for token donation flows	Provided guidance on UTXO handling, transaction building, network guard, and GraphQL integration; assisted with debugging transaction failures; shared best practices for ADA/token combo donations