



SDG BLOCKCHAIN ACCELERATOR

ROADMAP

Challenge Definition

UNDP Challenge Summary

Critical minerals such as cobalt, tantalum, and rare earths are essential for modern economies and the global energy transition. The material intensity of renewable energy technologies is 200-300% higher than that of fossil fuels, which has led to a sharp increase in demand. According to the International Energy Agency (IEA), demand for certain critical minerals could quadruple by 2040 under current climate commitments.

However, supply chains remain fragile, fragmented, and often opaque. Extraction and processing frequently occur in regions with fragile ecosystems and governance challenges, creating risks for environmental sustainability, human rights, and political stability. Mid-sized mining operations, which could fill short-term supply gaps, lack access to transparent and affordable financing. This financing gap forces communities and operators to rely on informal or high-risk capital, further undermining sustainability and accountability.

The combination of soaring demand, fragile ecosystems, and opaque supply chains poses a systemic development challenge: without transparent, ESG-compliant financing and monitoring mechanisms, both the energy transition and the economic independence of resource-producing countries are at risk. Addressing this gap is essential for meeting the goals of the Paris Agreement and the UN Sustainable Development Goals (SDGs), particularly those related to industry, innovation, responsible consumption, and climate action.

Local Context

The Europe and Central Asia region holds substantial reserves of critical raw materials (CRMs), with Kazakhstan, Türkiye, Serbia, and Ukraine among the most strategically positioned countries. These resources have the potential to strengthen regional economic independence and contribute significantly to the global energy transition. However, the sector faces persistent challenges in environmental and social governance (ESG), particularly around transparency, sustainable practices, and conflict-sensitive development.

Communities dependent on mid-sized mining operations are often excluded from international financing flows, leaving them reliant on informal capital and vulnerable to market volatility. At the same time, governments in the region are under pressure to ensure secure, transparent supply chains that meet EU critical mineral strategies and international sustainability standards.

Several initiatives have sought to address these issues, including EU-supported CRM policies, UNDP regional programs, and national reforms. Yet, gaps remain in connecting local mining operators, refiners, and cooperatives with institutional investors and global value chains. Without mechanisms for transparent financing and ESG-compliant monitoring, the region risks losing both competitiveness and long-term sustainability.

This challenge matters because the stakes go beyond economics: it affects energy security, climate commitments, and social stability. By enabling sustainable CRM-linked value chains and supporting circular economy approaches, stakeholders such as national governments, the private sector, civil society, and international development banks can foster a more resilient and responsible mineral economy for the region.

Relevance to UNDP CO Priorities and Resource Mapping

This project directly aligns with the UNDP Istanbul Regional Hub priorities in Europe and Central Asia, which emphasize inclusive economic transformation, sustainable resource management, and resilience against geopolitical and environmental risks. By focusing on critical raw materials (CRMs), the initiative supports UNDP's mandate to foster transparent, accountable, and conflict-sensitive economic growth, while also contributing to the Paris Agreement and the Sustainable Development Goals (SDGs 7, 8, 9, 12, 13).

The project builds upon existing UNDP and EU initiatives targeting sustainable mining, circular economy development, and supply chain transparency. Notably, it complements regional CRM strategies, as well as UNDP's efforts to strengthen governance and institutional capacities in fragile sectors. By integrating blockchain-based transparency and ESG-compliant financing, BlackFrog adds an innovative financial dimension that existing projects lack.

In terms of resource mapping, there is potential for co-financing and partnership support from:

Development banks (e.g., KfW, IFC, EBRD) that already fund sustainable infrastructure and mining governance.

Donor governments and EU programs that prioritize CRM security and supply chain resilience.

Private sector and institutional investors (e.g., pension funds, ESG funds) interested in regulated, tokenized access to CRMs.

Human resource contributions from academic and civil society partners (e.g., University of Leipzig, NGOs working in mining governance).

This combination ensures the project is not a standalone initiative but rather an extension of existing frameworks, filling the critical gap of transparent, ESG-aligned financing for mid-sized mining operations and value chains.

Expected Impact (from CO perspective)

As the Challenge Owner, the UNDP Istanbul Regional Hub expects this pilot to demonstrate how critical raw material (CRM) financing can become more transparent, accountable, and ESG-aligned. A successful outcome would:

Provide evidence-based recommendations for policy change or regulatory adjustment, strengthening national and regional CRM governance.

Establish a reference model for CRM value chain best practices, including financing standards, ESG-compliance benchmarks, and transparency mechanisms.

Improve service delivery to mining communities and mid-cap operators by enabling structured access to international financing instead of informal or high-risk capital.

Contribute to systems improvement by linking local CRM production to global institutional investors through blockchain-enabled transparency.

Lay the foundation for scaled innovation, allowing replication across Central Asia and beyond, while reinforcing UNDP's role as a convener for sustainable and conflict-sensitive resource management.

Target SDGs and SDG Indicators

SDG 7 - Affordable and Clean Energy

Indicator 7.2.1: Renewable energy share in total final energy consumption.

By securing critical minerals for batteries and renewable technologies, the project supports scaling clean energy infrastructure.

SDG 12 - Responsible Consumption and Production

Indicator 12.2.1: Material footprint, material footprint per capita, and material footprint per GDP.

Transparent financing and cobalt certificates promote responsible resource use and circular economy models.

SDG 13 - Climate Action

Indicator 13.2.1: Number of countries that have integrated climate change measures into policies, strategies, and planning.

By offering ESG-compliant financing, the project enables governments to align CRM supply chains with climate commitments.

SDG 16 - Peace, Justice, and Strong Institutions

Indicator 16.6.1: Primary government expenditures as a proportion of original approved budget, by sector.

Blockchain-based transparency fosters accountable institutions and reduces reliance on opaque, conflict-prone financing channels.

User & Problem Mapping

Primary Users:

Mid-cap mining operators and cooperatives in Central Asia.

Problem: Lack access to international capital markets; reliant on informal or high-risk financing.

Aim: Secure transparent, affordable, and ESG-compliant financing to expand production sustainably.

Institutional investors (pension funds, development banks, ESG funds).

Problem: Limited access to verified and transparent CRM investment opportunities.

Aim: Deploy capital into regulated, ESG-aligned projects that meet both financial return and sustainability goals.

Secondary Stakeholders:

Refiners and traders:

Require consistent and compliant mineral supply for global value chains.

Governments and regulators:

Need transparent financing mechanisms to strengthen governance and align with EU CRM strategies.

Civil society & NGOs:

Seek to reduce environmental and social harms while ensuring community benefits.

Communities near mines:

Impacted by extraction activities; stand to gain from more sustainable financing and monitoring.

Systemic Challenge:

Opaque financing and weak governance create risks of environmental degradation, conflict financing, and loss of competitiveness. Bridging users (miners/investors) and stakeholders (governments/NGOs) through a transparent platform addresses both financing gaps and systemic governance challenges.

Solution Summary

BlackFrog is a **blockchain-enabled investment and tokenization platform** that provides transparent, ESG-compliant financing for critical raw materials (CRMs) such as cobalt, tantalum, and rare earths. It bridges the gap between **mid-cap mining operators** who lack access to traditional finance and **institutional investors** seeking sustainable, verifiable opportunities.

Core Functionalities

Mining and refining projects are structured into tokenized bonds, issued under EU financial licenses (custody, brokerage, eWpG).

Investors purchase these bonds using fiat or stablecoins, with transactions settled on Cardano for traceability and cost efficiency.

Smart contracts manage issuance, yield distribution, and redemption, ensuring automated compliance and transparency.

ESG metrics and impact reporting are integrated into the platform, giving investors real-time visibility into project outcomes.

Tech Stack Overview

Front-end: React-based web application with institutional-grade dashboards for investors, miners, and regulators.

Back-end: Node.js/TypeScript services integrated with Cardano APIs (Ogmios, Kupo) for blockchain interaction.

Smart contracts: Structured financing and yield distribution contracts (Plutus).

Data sources: ESG compliance data from partner audits, project-level reporting, and oracles for external verification.

Integrations: Fireblocks for custody, API links to partner banks and refiners.

Cardano-Specific Elements

Token minting & burning: Each bond issuance represented by security tokens minted on Cardano.

Plutus smart contracts: Manage issuance, yield payouts, and redemption with automated compliance checks.

Metadata tagging: Embeds ESG and SDG-related data directly into transactions for transparent reporting.

UTxO tracking: Ensures transparent monitoring of fund flows and project repayments.

Verifiable credentials (VCs): Enable identity and compliance verification for miners, refiners, and investors.

Prototype Plan (Sprint-Based)

This section outlines your team's rapid prototyping plan. The goal is to build a functional and demonstrable version of the solution within 10 working days, with user feedback integrated.

Prototype Goal

(State what your team aims to build and validate during the sprint. Keep it focused, achievable, and linked to the broader MVP vision.)

Expected Outputs

(List the minimum outputs required for a successful prototype. These should be specific, measurable, and demo-ready.)

- One working interaction (e.g., VC issuance, token minting)
- On-chain or hashed output with SDG metadata
- User interface (form, display, interaction)
- Stakeholder feedback (minimum 3 sessions)

Sprint Timeline

(Break down the 10-day sprint into tasks and outcomes. Use this as a working plan for the team to stay aligned and focused. The table below is just an example. Please feel free to adapt the tasks and outcomes based on your solution's specific needs and development approach.)

Day	Description	Outcome
1	Define scope & SDG Indicators	Scope clarity
2	UX & flow design	Figma/Flow ready
3	UI implementation	Frontend in place
4	Chain integration	VC/token tested
5	Mid-review & QA	Testing link ready
6-7	Stakeholder testing	Feedback gathered
8-9	Iteration & polish	Demo-ready version
10	Final submission	All deliverables done

Success Metrics & Milestones

Tracking progress throughout the accelerator is key to building momentum and measuring real impact.

Below is a set of baseline success metrics that all teams are expected to work toward during the sprint, MVP refinement, and pilot-readiness phases. These ensure a consistent level of development and stakeholder engagement across all projects.

Teams are also encouraged to define additional metrics that are specific to their solution, context, and strategic goals. These custom metrics can relate to: social or environmental impact, technical milestones, community adoption, strategic partnerships, innovation outcomes.

Sprint Phase

Focus: Rapid prototyping, initial user testing, and validation of core functionality.

Category	Baseline Metric
Blockchain Interaction	One meaningful blockchain function implemented (e.g., token minting, VC issuance, on-chain hash).
User Interface	At least one working UI screen or flow (e.g., form, dashboard, display screen).
Stakeholder Testing	Minimum 3 live or async testing/feedback sessions with relevant users or stakeholders.
SDG Integration	Incorporate SDG logic or tags into the metadata, user interface, or output, focusing on indicators your solution actively addresses.
Demo Readiness	Demo link or video walkthrough prepared and submitted by Day 10.

Post-Sprint Refinement

Focus: Iterating based on feedback, improving functionality, and aligning with pilot opportunities.

Focus Area	Baseline Metric
Feedback Integration	Minimum two user- or stakeholder-driven changes implemented in logic or UX.
MVP Stabilization	Functional testing completed with consistent results and no major blockers.
Stakeholder Alignment	At least one follow-up session with a CO or stakeholder to discuss next steps.

Pilot Readiness

Focus: Preparing the solution for deployment and scaling.

Goal Area	Suggested Metric
Institutional Buy-In	CO expresses interest in pilot exploration; early MoU or agreement in discussion.
Solution Readiness	MVP tested in an extended or external environment; improvements implemented.
Sustainability Path	Initial plan for post-program ownership or funding drafted.

Cumulative Tracking Suggestions

Consider using a simple dashboard or milestone tracker across the weeks to monitor:

- % completion of prototype milestones
- % of users tested
- % of stakeholder feedback items received & integrated
- % SDG contribution implemented in technical flow
- Progress toward pilot validation (e.g., 0-100 scale)

MVP Planning Table

After the prototype sprint, you'll begin shaping the full MVP. This table helps identify what's already been built, what needs improvement, and how each component will evolve into a pilot-ready version.

Component	Prototype Status	Improvement for MVP
UI/UX	[e.g., Form built]	KYC, Investor management, Issuance
Blockchain	Fundraiser Sc's	Add stablecoin
SDG Tags	ESG Compliance	External Audits
Feedback	[e.g., 3 sessions]	[e.g., Expand to 5+ users]

Risk & Assumptions

Every project has uncertainties. Use this table to proactively identify key risks and assumptions and describe how your team plans to address them.

Risk/Assumption	Description	Risk Level	Risk Mitigation Strategy
Licencing	Licencing adapted to Cardano SCs	High	Pair devs with mentors

Team Profile

Our international team of commodity and computer engineers is well connected in the commodity sector and web3 space. In europe, we work with the UN, development banks, the ESA and the german ministry of economics and energy. In Africa, we work with various governments, including the D.R. Congo. As early defi adopters, we like to put on a suit or rubber boots as needed and have a feel for momentum and market trends. we know how to build the first commodity unicorn in DeFi.

Solution Makers

Introduce the team behind the solution, highlighting relevant skills and backgrounds that contribute to your ability to execute this project successfully.

Team Name
BlackFrog

Team Members & Roles

- Tchoukoua Tchatchoua Boston – CTO, Software Engineer (Cardano)
- Julian Wikalinski - CEO
- Cedrick Koudja - COO, mining engineer

- *Nareph Frank Menadjou* - Software Engineer
- *Ziyad Alagla* - Software Engineer

Challenge Owners

The UNDP Istanbul Regional Hub or institutional partners who defined the development challenge and provided critical context, feedback and collaboration throughout the accelerator.

Challenge Owner Organization Name:

UNDP Istanbul Regional Hub

Team Members & Roles:

- *Dani* - Programme Specialist - Governance & Peacebuilding
- *Josip Ivanovic* - Programme Specialist - Governance & Peacebuilding
- *Marina Mclellan* - Programme Specialist - Governance & Peacebuilding

Area of Focus:

Critical & raw mineral, climate-peace-security agenda

Notes & Insights

Use this section to capture key learnings, challenges, or insights discovered during prototyping. This could include quotes from stakeholders, reflections on usability, or ideas for future iterations.

(Examples:

- "Users found the onboarding form too long."
- "Stakeholders appreciated transparent SDG contribution."
- "Potential opportunity to integrate with local registry in next phase.")

Pilot Vision & Scalability Plan

The pilot will validate BlackFrog's model by structuring and issuing a first tokenized bond with a verified mid-cap mining project in Kazakhstan. This initial case will demonstrate the full cycle of investment structuring, issuance, yield distribution, and repayment tracking, while providing a proof of transparency and ESG compliance for institutional investors and development partners.

Based on the pilot's results, the solution will scale regionally to additional projects across Central Asia, expanding from 1-2 projects to 10-15 within 12 months. Partnerships with refiners, traders, NGOs, and development banks will ensure a robust ecosystem that secures supply chains and broadens investor adoption.

In the long term, the platform will evolve into a marketplace for critical mineral financing and ESG-linked certificates (e.g., cobalt certificates similar to CO₂ offsets), creating scalable instruments for both investors and governments. This will position BlackFrog as a replicable model for transparent, sustainable, and conflict-sensitive CRM financing worldwide.

Pilot Vision (6-12 months)

Success in the pilot phase will be defined by the ability to demonstrate transparent, scalable, and ESG-compliant financing for critical minerals. Key outcomes include:

First tokenized bond issuance with a mid-cap mining project in Kazakhstan, covering the full cycle of structuring, investment, yield distribution, and repayment.

Proof of transparency through on-chain tracking of capital flows, investor returns, and ESG reporting.

Institutional validation, with at least one development bank or institutional investor participating.

Demonstrated efficiency gains, reducing time and costs compared to traditional financing routes.

Foundation for scale, with 3-5 additional mining, trading, or refining projects prepared for onboarding.

Target Users or Communities for Pilot

The pilot will directly benefit:

Mid-cap mining operators in Kazakhstan, particularly those extracting critical raw materials essential for the energy transition (e.g., cobalt, rare earths). These actors will gain access to structured, transparent financing.

Institutional investors and development banks, who will be able to deploy capital into ESG-compliant, traceable mineral projects with reduced risk.

Refiners and international traders, who will benefit from more reliable supply chains backed by transparent financing structures.

Policy and regulatory bodies in Central Asia, who will gain a best-practice example for integrating blockchain-enabled financing models into critical mineral value chains.

Local communities indirectly benefit through more stable employment and improved ESG compliance in financed projects.

Scalability Plan

Reusable Elements:

The tokenization and yield-distribution smart contracts can be replicated for different minerals, geographies, and investor groups.

ESG due diligence and reporting modules are adaptable across contexts, ensuring compliance with local and international standards.

Partnerships with refiners, traders, and development banks can be expanded to new supply chains.

Scaling Path:

Phase 1 (Kazakhstan): Establish proof-of-concept with mid-cap mines.

Phase 2 (Central Asia & Balkans): Onboard 10-15 mining, refining, and trading projects with institutional co-financing.

Phase 3 (Global Expansion): Extend to Sub-Saharan Africa and other resource regions, integrating additional commodities (e.g., cobalt certificates for offsets).

Impact: By replicating the model, BlackFrog can grow into a pan-regional marketplace for critical mineral financing, providing investors with diversified, ESG-aligned opportunities while securing supply chains for the global energy transition.

Support Needed

To move forward with the pilot and ensure scalability, BlackFrog requires:

Technical Support: Integration assistance for tokenization and wallet infrastructure, external audits for smart contracts, and ESG data oracles to validate project compliance.

Policy Support: Engagement with regulators in Central Asia to align tokenized bonds with securities and resource governance frameworks, ensuring legal clarity for cross-border investment.

Funding Support: Seed financing to structure the pilot bond and cover legal, audit, licensing, and onboarding costs for the first mining/refining projects. Co-financing from development banks or institutional investors will be critical for scale.

Partnership Support: Collaboration with international NGOs, mining associations, and development finance institutions to expand networks and establish credibility in new markets.

Sustainability & Business Model (optional)

If relevant, describe how the solution can be sustained over time (financially, operationally, or institutionally).

Business or Funding Model

Financial: Revenues are generated through structuring fees (e.g., 1-2% of tokenized bond volume), platform service fees, and ESG certificate issuance (e.g., cobalt offsets). This creates recurring income streams tied directly to the growth of financed projects.

Operational: The tokenization engine, due diligence process, and smart contracts are reusable across regions and minerals, minimizing marginal costs for scaling. Local partnerships with refiners, traders, and banks ensure operational resilience.

Institutional: By aligning with development banks, UNDP priorities, and regulatory frameworks (e.g., EU MiFID II, eWpG), the model embeds itself in international standards, ensuring long-term legitimacy and adoption.

Key Resources & Partnerships

Licensing & Regulatory Access: EU-wide custody, brokerage, and electronic securities (eWpG) licenses provide the legal foundation to issue and manage tokenized bonds across jurisdictions. Continued engagement with regulators in Central Asia will ensure compliance and scalability.

Technical Infrastructure: Cloud hosting, blockchain node operations (Cardano), smart contract development, and ESG data oracles to ensure transparency and reporting.

Human Capital: Development talent for blockchain engineering, financial structuring expertise (ex-development bank sector), and ESG specialists for due diligence.

Strategic Partnerships: Collaborations with refiners, traders, and mid-cap mines for pipeline development; international NGOs and mining associations for ecosystem integration; development banks and institutional investors for co-financing and scaling.

Long-Term Ownership / Maintenance

BlackFrog will retain full ownership and operational responsibility for the platform after the pilot. Our team will continue to manage the technical infrastructure, regulatory compliance, and project onboarding processes, ensuring consistent standards across all regions.

While core maintenance will remain in-house, we will engage selected partners (e.g., development banks, refiners, and institutional investors) for project pipeline development and ESG auditing, while preserving BlackFrog as the primary operator and custodian of the solution.

Deliverables Checklist

Use the checklist below to ensure all relevant final materials are prepared and submitted for review.

These are the suggested key outputs from the prototype sprint, not all items may apply to every team or solution, so please adapt as needed based on your project's scope and stage.

Please link all deliverables in a dedicated shared folder for your team for easy access by the program team and stakeholders.

- Prototype demo link
https://drive.google.com/file/d/1ylv_J9b58L0LAstu3tw2viAH2i3TAxH7/view?usp=drive_link
- Source code / GitHub repo
<https://github.com/Elizaproai/rwa-cardano-launchpad>
- Documentation / ReadMe
- SDG metadata logic
- Feedback summary
- Video walkthrough
- Feedback from Country Office
- Next steps agreed (e.g., pilot planning?)

Team Reflection

Use this space to share key takeaways and reflections from both the Challenge Owner and Solution Maker teams. This dual perspective helps document alignment, evolution of understanding, and mutual growth during the accelerator journey.

Challenge Owner's Perspective

- A deeper understanding on the practical implementation of blockchain to a specific development challenges within our context.
- Learning to build collaboration with multi-stakeholders in particular the technical teams, which have different perspective and approach.
- Exploring potential solution in relations to critical and raw mineral, as well as the Climate, Peace, and Security Agenda.

Solution Maker's Perspective

- Building with Cardano was new for us, and we now feel more confident integrating blockchain in real-world systems.

