



NCU.fi: The Bridge Linking Capital to Global Sustainable Impact

*The trusted economic infrastructure that
connects capital with accountable, nature-
positive outcomes to drive global sustainability.*

Version 1.0.0

Content

Executive Summary	3
Part 01: The Capital-Flow Imbalance	4
Part 02: Project-Level Causes: Trust, Cost, and Reward Gaps	6
2.1 The Trust Gap: Fragmented Project Context	6
2.2 The Cost Barrier: Repeated Evidence and Coordination	6
2.3 The Reward Gap: Fragmented Revenue and Recognition	7
Part 03: Converging Trends Across the Sustainability Economy	8
3.1 Regulation Is Moving Towards Accountable Real-World Activity	9
3.2 Sustainability Is Becoming an Industrial and Capital Requirement	9
3.3 Programmable Finance, RWA, and Product Lifecycle Markets	10
3.4 AI, Digital Experiences, and Agent-Mediated Markets	10
Part 04: NCU.Fi: The Bridge Linking Capital to Global Sustainable Impact	12
4.1 Market Positioning	12
4.2 Two Design Principles	13
4.3 Project-Based Reward Architecture	13
Part 05: Protocol Architecture: From Evidence to Governed Project State	15
5.1 Solution in One View	16
5.2 What Enters the System	17
5.3 NCU.Gen: Project, Evidence and Coordination System	18
5.4 From Reviewed Evidence to an Authorised Record	19
5.5 Project Contract: Project Identity and Operation Log	20
5.6 Credential Contract Suite: Evidence Review and Authorised Actions	20
5.7 NCU Allocation Contract and Project Participation Record	21
5.8 Credential Types and Application Policies	22
5.9 Protocol Permissions and Multi-Chain Access	23
5.10 Architecture as One Continuous System	23
Part 06: Project Infrastructure as a Service and Application Directions	24
6.1 Natural Assets and Sustainable Real-Economy Infrastructure Services	24
6.2 Institutional Finance, ESG Instruments, Public Programmes, and Empowered RWA	25
6.3 Supply-Chain, Project-Origin Commerce, and Product Lifecycle Records	26
6.4 Digital Industries, Immersive Experience, and Participation	27
6.5 Participation Spectrum and Boundaries	27
Part 07: Ecosystem Economics: NCU Allocation, Project Participation, and Utility	28
7.1 NCU Functions in the Economic Model	28
7.2 Proof-of-Deployment and Immediate Allocation	29
7.3 Project Allocation Records and Contribution Ledger	30
7.4 Fixed Supply and Project Formation Reward Rate	30
7.5 Where NCU Is Used	33
Part 08: Current Application Directions	34
8.1 One Architecture Across Three Public Project Contexts	34
8.2 Nature Performance Credit Concept	35
Part 09: Risk, Governance, and Regulatory Boundaries	37
Part 10: Long-Term Vision: From Static Projects to Agent-Ready Project Economies	40
References	42
Glossary	45

Executive Summary

Climate instability, energy-security pressures, biodiversity loss and resource constraints are reshaping how economies develop, invest and manage long-term risk. At the same time, the rapid growth of Artificial Intelligence (AI) and digital technologies is creating new demand for energy, materials and resilient physical systems. Real-world projects that advance sustainability are becoming practical vehicles for directing capital into this transition. These projects create commercial outputs together with wider public and environmental value. They can supply food, energy and materials, strengthen infrastructure, reduce risk and improve natural systems. However, only a fraction of this value translates into investable opportunities and sustained economic returns. NCU.fi aims to help more capital enter these projects and build a more complete financial and economic ecosystem around the value they create.

The central constraint is trust. Capital deployment, accountable activity, evidence, outcomes, and claims are often handled through separate systems, making the persistent history of a project difficult to verify and reuse. This fragmentation also raises costs by requiring evidence preparation, review and acceptance to be repeated for each new financing, credential, procurement or product pathway. Reward is also fragmented: green finance, public programmes, procurement, product premiums and environmental credits each recognise part of a project's value. A trusted and reusable project history can connect these pathways while preserving the rules, methodologies and authority of their respective markets.

NCU.fi is a blockchain-based digital network that bridges capital and global sustainable impact. Its foundation is a persistent project state connecting capital deployment, reviewed evidence, credentials, and authorised market use. Independently assessed information remains connected to one project history, while each methodology, institution and market retains authority over its own decisions. This continuously updated project state provides a trusted foundation for transactions in real-world products, enterprise credentials and procurement evidence, eligible environmental assets, project-linked digital products, finance and public participation. The same trust layer can also serve digital applications such as games and digital twins.

Projects initiate when individuals and organizations commit capital, resources, and labor to generate value that may take years to commercialize. NCU.fi recognises eligible participation once the relevant contribution has been evidenced and approved. Participants receive Natural Capital Unit (NCU), the network-native unit required for designated project-state updates, services and interactions across NCU.fi. Project Contract records preserve who participated and when, while earlier project formation receives stronger relative recognition across the long-term reward path.

NCU.fi follows financial effort-based recognition, verified and updated by measured outcomes. It first supports nature-positive projects, where established monitoring methods, environmental indicators and review frameworks provide a practical basis for measuring outcomes and testing the model under real-world conditions. Over time, the same infrastructure can support a wider range of accountable real-world projects and authorised AI-agent applications. Its long-term opportunity is to become the verified project and reward layer for an agentic real-world economy.

The Capital-Flow Imbalance

Economic development depends on functioning natural and physical systems. Food production, energy security, cities, industry, and supply chains all rely on stable climate conditions, productive land, water, and resilient infrastructure. Real-world projects that advance sustainability are the practical units through which capital can protect, restore or improve these systems while producing goods and services for the economy.

Nature-positive projects provide the starting point because natural systems form the biophysical foundation of human well-being and economic activity. These projects unfold over long time horizons and can draw on established ecological monitoring methods, environmental indicators and review frameworks, while retaining the location-specific context required for credible assessment. They therefore provide a rigorous setting in which to examine the capital-flow imbalance.

The scale and direction of this imbalance are visible in the following indicators:

- PwC estimated that around 55% of global GDP, approximately US\$58 trillion, is moderately or highly dependent on nature. [1]
- The World Economic Forum ranked extreme weather, critical change to Earth systems, biodiversity loss and ecosystem collapse, and natural resource shortages among the most severe long-term global risks in its 2024 Global Risks Report. [2]
- WWF's 2024 Living Planet Report found an average 73% decline in monitored wildlife populations between 1970 and 2020, indicating deep stress across monitored ecological systems. [3]
- The Kunming-Montreal Global Biodiversity Framework identifies the need to close a biodiversity finance gap of roughly US\$700 billion per year. [4]
- UNEP estimates that in 2023, US\$7.3 trillion flowed into nature-negative activities, US\$220 billion supported nature-based solutions and private finance contributed US\$23 billion. For every US\$1 invested in protecting nature, around US\$30 supported activities that degrade it. Investment in nature-based solutions needs to rise to approximately US\$571 billion annually by 2030 to meet biodiversity, climate, and land-restoration targets. [5]

US\$700B Gap

on biodiversity finance

73% Decline

of wildlife populations (1970-2020)

55% GDP

is dependent on nature

30:1

Nature Finance Imbalance

The imbalance is economic as well as environmental. Such projects may create saleable products, reduce operating and physical risks, improve access to finance or procurement, and generate benefits that are recognised through public or environmental programmes. Too little of that value becomes dependable revenue, financing advantage, market access, or persistent reward for the projects and participants that create it.

For capital, the central question is whether these benefits can form a sufficiently credible and persistent economic proposition relative to project risk, cost, and time. This whitepaper examines how project-level infrastructure can help more capital enter the sustainability economy, support accountable activity and generate economic pathways that continue beyond a single report, transaction or credit. The same capital-flow imbalance also appears in clean energy, circular production, sustainable materials, resilient infrastructure, the bioeconomy, and responsible supply chains. The following chapter examines the project-level conditions behind it.

Project-Level Causes: Trust, Cost, and Reward Gaps

One important project-level cause of the capital-flow imbalance described in Chapter 1 is that only a limited share of the value created by projects reaches finance, procurement, credentials, products and other market uses. The problem begins with trust: capital deployment, accountable activity, evidence, outcomes and claims are held across separate systems, so each pathway rebuilds its own understanding of the project.

This repeated work raises the cost of financing, review, and market access. Existing revenue and reward mechanisms then recognise only part of the project's economic, environmental, and participation value. The result is a weaker economic proposition for the project and less capital entering the sector. The following sections examine the three connected barriers behind this pattern: trust, cost, and reward.

2.1 The Trust Gap: Fragmented Project Context

Trust at the project level extends beyond mere scientific validity. Capital providers need confidence in how funds are used; enterprises and buyers need confidence that credentials, products and claims remain connected to accountable activity; and reviewers need to know which version of the evidence applies, who is responsible, and what claim boundary governs its use. Fragmentation across these relationships creates greater exposure to inconsistent disclosures, duplicate use and greenwashing.

Nature provides a demanding example. Biodiversity outcomes may depend on location-specific baselines, multiple ecological indicators, additionality, permanence and independent verification. [6] A verified carbon unit expresses a quantified reduction or removal in tonnes of carbon dioxide equivalent under a carbon methodology, while a production credential may establish conformity with defined processes or product rules. [7] These value systems answer different scientific, commercial and regulatory questions.

Their scientific, commercial and regulatory differences are necessary. The trust gap arises because they lack a common project context in which each assessment can retain its own methodology, scope, evidence version and claim boundary while remaining attributable to the capital and activity that produced it. Evidence and determinations consequently remain within specialised systems, limiting their use across the project lifecycle.

2.2 The Cost Barrier: Repeated Evidence and Coordination

Organisation for Economic Co-operation and Development (OECD) research identifies measurement, reporting, and verification (MRV) systems, data systems, and public registries as foundational market infrastructure for nature markets, noting that standardised data and reporting are important for reducing information asymmetry, enabling due diligence, and attracting private investment.[70] In practice, however, funding, project operation, MRV, certificate issuance, trading, and investment are often handled by different parties, each relying on different data systems, evidence requirements and assessment processes. As a result, project information and evidence are fragmented across organisations and stages of the project lifecycle.

This fragmentation creates repeated evidence requests, duplicated administrative work, and costly due diligence. Evidence from the voluntary carbon market illustrates the scale of the problem: project developers can spend up to 60% of their time managing and responding to project-data requests, while buyers can spend up to 18 months conducting due diligence on a single project.[71] Project developers and buyers may also pay \$15,000–\$50,000 per service provider for data- and diligence-related services, with total data-related transaction costs exceeding \$100,000 per project in some cases.[71]

Across a longer project lifecycle, this fragmentation also weakens the connection between capital and work committed at an early stage, the evidence generated through project implementation, and the credentials, products, revenues, or participation rights that emerge later.

2.3 The Reward Gap: Fragmented Revenue and Recognition

Projects that advance sustainability already receive multiple forms of reward. Carbon credits provide the most established example of a market mechanism that monetises a defined environmental outcome. Nature credits and other environmental units are developing alongside them. Sustainability-linked loans can connect financing terms to defined performance. Procurement access, public programmes, tax or subsidy mechanisms, product premiums, risk reduction, insurance benefits, brand value, and customer demand can each recognise part of a project's contribution.

These mechanisms are important building blocks. Carbon and nature standards define eligible environmental units; green bonds and sustainability-linked finance mobilise capital; public programmes fund public objectives; and Regenerative Finance (ReFi) and Real-world Assets (RWAs) experiments demonstrate new programmable forms of environmental assets, real-world assets and participation, together with the persistent importance of project quality, evidence governance, and market acceptance. [8] [9] Each mechanism performs a specialised function and remains governed by its own rules.

The economic difficulty lies in their separation. Some project value has no mature pathway to revenue or financial recognition. Where a pathway does exist, overlapping project facts are commonly assembled and accepted again under a separate process. At the enterprise level, this raises the marginal cost of each additional financing, procurement, reporting, or product use. Across the project lifecycle, it prevents capital providers and operators from seeing how independently governed benefits may contribute to one persistent economic proposition.

These three market pain points converge on a single requirement: a persistent project record that drives sustainability, maintains verifiable context, minimizes coordination overhead, and accommodates diverse revenue and incentive models. Chapter 3 examines the wider market and technology shifts that make this requirement increasingly relevant.

Converging Trends Across the Sustainability Economy

Markets connected to the sustainability transition are expanding across infrastructure, energy, manufacturing, agriculture, the bioeconomy, finance and product systems. Although these markets serve different purposes, they increasingly depend on attributable information about capital deployment, accountable activity, performance, products and persistent project history.

The following table provides an indicative snapshot of selected sustainability-linked sectors and markets and the project-level requirements emerging within them. The figures use the most relevant scale measure available for each market—including annual investment, economic activity and financing need—and provide directional context rather than a directly comparable market-size series. Together, these indicators show the scale and direction of sustainability-linked markets whose financing, products, rights and economic value increasingly depend on persistent, attributable project information.

Sustainability-linked sector or market	Indicative scale and direction	Emerging project-level requirement
Climate-Compatible Infrastructure	approximately US\$6.9 trillion per year required through 2030 [10]	attributable capital deployment, milestones, performance, procurement and persistent project or asset history
Clean-Energy Investment	approximately US\$2.2 trillion expected in 2026 [11]	connected records for generation, storage, grids, industrial transition, land, water, communities and supply chains
Clean-Technology Manufacturing	approximately US\$200 billion of recent annual investment across key technologies [12]	productive-asset identity, use of funds, manufacturing activity, circularity, finance and persistent reporting
Agriculture and The Bioeconomy	US\$4.0 trillion of global agricultural value added in 2023, within a global bioeconomy estimated at approximately US\$4-5 trillion [13] [14]	producer and project identity, production activity, biological materials, product batches, provenance and credentials
Climate and Sustainability Finance	approximately US\$1.9 trillion of tracked climate finance in 2023, while aligned green, social, sustainability and sustainability-linked debt issuance exceeded US\$1 trillion in 2025 [34] [35]	use of funds, milestones, performance indicators, instrument-to-project linkage and persistent reporting
Nature-Based Solutions	US\$220 billion invested in 2023, with approximately US\$571 billion per year required by 2030 [5]	methodology-specific baselines, monitoring, reviewed outcomes, claim status, finance and participation history

3.1 Regulation Is Moving Towards Accountable Real-World Activity

Sustainability is shifting from broad commitments towards evidence-based operating requirements. Annual reports and ratings remain important, while regulation and market practice are bringing real-world activity closer to financing, procurement and product decisions. This increases demand for clear project identity, responsibility, evidence and claim boundaries.

The direction is global. Europe is advancing carbon-border rules, green-claims controls, biodiversity disclosure, deforestation traceability and product lifecycle information. [16] [17] [18] [19] [20] [21] Across Asia-Pacific, sustainability reporting, carbon pricing and nature-market infrastructure are also developing. [22] [23] [24] [25] [26] [27] [28] Related measures in the Americas include climate disclosure, regulated carbon markets, sustainable taxonomies and climate-risk expectations. [29] [30] [31] [32]

At global level, direct carbon pricing now covers nearly 30% of greenhouse-gas emissions across 87 implemented policies and mobilised more than US\$107 billion for public budgets in 2025. [33] Policy increasingly makes sustainability information a condition of market access and economic participation.

3.2 Sustainability Is Becoming an Industrial and Capital Requirement

Climate risk, energy security, resource constraints, and supply-chain resilience increasingly affect business performance. Global tracked climate finance reached approximately US\$1.9 trillion in 2023, while aligned green, social, sustainability, and sustainability-linked debt issuance exceeded US\$1 trillion again in 2025. [34] [35]

Sustainability is also becoming part of industrial infrastructure. Water, transport, buildings, data centres, food systems, and manufacturing depend on resilient natural and material systems. The bioeconomy illustrates this expansion by connecting biological resources with sectors ranging from agriculture and food to biotechnology and new materials. The European Union (EU) estimates its bioeconomy at approximately EUR2.7 trillion and its biotechnology sector at more than EUR720 billion. [36] The Convention on Biological Diversity (CBD) Cali Fund similarly links the value of genetic resources with commercial industries and scientific services. [37]

Science and monitoring systems are making the underlying activity more observable. Remote sensing, field measurements, laboratory records and connected sensors can establish defined conditions and results. For capital and enterprise users, the next requirement is to connect this information to a responsible project, an authorised review and a permitted economic use.

3.3 Programmable Finance, RWA, and Product Lifecycle Markets

Tokenisation and programmable finance are fundamentally reshaping the representation and coordination of real-world assets, rights, and financial processes. Bank for International Settlements (BIS) describes tokenisation as a progression that can integrate messaging, reconciliation, and asset transfer on programmable platforms. [38] Public market snapshots place tokenised RWA value excluding stablecoins in the tens of billions of US dollars in 2026, indicating an early but expanding market. [39]

Sustainability-linked RWA presents a further opportunity. A financial instrument may represent an asset, loan, revenue right or fund interest, while the sustainability value created by the underlying project remains only partially visible. Sustainability-linked finance already demonstrates that financial characteristics can respond to defined performance indicators and verification. [40] The emerging direction is to connect financial instruments more closely with evidence of how the underlying project uses capital and performs over time.

Product markets are moving in the same lifecycle direction. The EU Digital Product Passport establishes interoperable product identity and lifecycle information across production, use and end-of-life processes. [41] This trend extends the information chain towards the project or producer from which a product originates. It also strengthens the case for recording project activity throughout its lifecycle, before a product reaches the point of sale. Together, programmable finance and lifecycle commerce point towards markets in which financial instruments and products retain authorised links to their project origins.

3.4 AI, Digital Experiences, and Agent-Mediated Markets

AI adoption is moving beyond content generation towards systems that can search, compare, monitor, and execute defined tasks. Stanford's 2026 AI Index reports that generative AI reached close to 53% population-level adoption within three years of its mass-market introduction, while corporate AI investment more than doubled in 2025. [42] The International Monetary Fund (IMF) describes agentic AI as systems capable of interpreting objectives and interacting with digital services with limited human input. In payments and commerce, this may gradually shift activity from human-initiated instructions towards agent-mediated decisions. [43]

This development increases the importance of machine-readable, attributable and permissioned real-world information. An authorised agent needs to understand what an object is, its current status, the evidence it may rely on and the actions it is permitted to take. As agents become more active in comparison and execution, verifiable state is likely to carry greater weight alongside price, availability and narrative.

Other technologies are expanding the ways in which physical projects can be observed and experienced. Digital twins and connected sensors bring structured real-world data into software, while Augmented Reality and Virtual Reality (AR/VR) and games create new forms of education and participation. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has combined mangrove sites with immersive media and interactive challenges, and The International Telecommunication Union (ITU) has developed a reference model for connecting physical and virtual worlds through digital twins. [44] [45]

Across these trends, policy, sustainable investment, tokenisation, product lifecycle data, and AI are moving sustainability-linked markets towards more accountable, connected and machine-readable real-world activity. They increase the importance of persistent, attributable and interpretable project information across financing, products, transactions and participation.

NCU.Fi: The Bridge

Linking Capital to Global Sustainable Impact

NCU.fi operates as a project-state infrastructure layer across existing standards, registries, financial infrastructure, and enterprise applications. Individuals and organisations can initiate project accounts and begin building a verifiable participation history from the project-formation stage, subject to protocol onboarding and review requirements. Each project is represented by a persistent smart-contract account that connects capital deployment, responsible activity, reviewed evidence, credentials, and authorised economic use over time.

This shared project context allows information assessed under different external methodologies to remain connected to one project history. Enterprises can use approved project state in procurement, reporting, finance and product workflows. People can discover and participate in projects or purchase project-linked products. Developers can build specialised applications on the same trusted layer.

This architecture responds directly to the three project-level barriers identified in Chapter 2:

Project-level barrier	NCU.fi response
Trust Gap — Fragmented Project Context	a blockchain-anchored Project ID and smart-contract account bring AI-assisted evidence checks, authorised expert review and signed evidence references into one persistent project record, while each methodology retains its scope and claim boundaries
Cost Barrier — Repeated Evidence and Coordination	a continuously updateable Project Contract records authorised state changes, while digital workflows, AI-assisted processing and smart-contract execution support the incremental reuse of approved information
Reward Gap — Fragmented Revenue and Recognition	trusted, lower-cost project state supports credentials and multiple financing, product, service and participation pathways; NCU rewards approved participation and serves as the unit for designated network services and interactions

4.1 Market Positioning

NCU.fi provides a persistent project-state layer that begins at project formation and connects capital deployment, accountable activity, reviewed evidence, credentials and authorised economic use over time. Existing standards, registries, issuers and financial institutions continue to govern their own methodologies, eligibility rules, instruments and claim boundaries. NCU.fi preserves the project context across these systems, enabling multiple applications to use the same attributable project history.

Market layer	Representative examples	Primary function
Environmental standards and registries	Verra, Gold Standard, Plan Vivo	Define methodologies, verify outcomes and govern environmental credits or credentials
Environmental asset / ReFi infrastructure	Toucan	Bring environmental assets into digital and programmable markets
RWA and financial infrastructure	Centrifuge and other RWA platforms	Structure, issue and manage financial assets or rights
Enterprise and product systems	Procurement, ESG reporting and Digital Product Passport systems	Use sustainability and product information for specific commercial or reporting purposes
Project Infrastructure Layer	NCU.Fi (NCU.Gen, Project Contracts and Credential Contract Suite)	Maintain the continuing project state linking capital, activity, evidence, credentials and authorised applications across these systems

4.2 Two Design Principles

NCU.fi's project and reward model follows two connected design principles:

Financial effort-based recognition, backed by measured outcomes. Natural and social value often emerges over long periods, varies by location and is assessed through multiple legitimate methodologies. NCU.fi begins recognition when accountable capital, resources, or labor have entered a defined project and the relevant participation has been evidenced and approved. Measured outcomes then update the persistent project state, credential scope, future eligibility, and permitted claims. This sequence provides timely recognition while keeping later economic use anchored to observable performance.

Stronger recognition for earlier participation. Early participants commit resources while project parameters—such as operating infrastructure, evidence processes, and market demand—are still in their nascent stages. Their participation helps establish the project record and the foundation used by later credentials, products and applications. Equivalent approved participation therefore receives stronger relative recognition earlier in the long-term reward path.

These principles shape how NCU.fi recognises project formation and connects participation with later project-state use.

4.3 Project-Based Reward Architecture

The NCU.fi reward architecture connects four layers of value:

1. **Trusted-state Value:** a persistent project account reduces repeated evidence preparation, preserves reviewed history and improves the project's capacity to enter approved applications. This is the enabling economic layer for the rewards that follow.
2. **External Market Rewards:** independently governed nature and carbon credits, credentials and certificates, sustainability-linked finance, procurement access, public programmes, product premiums and risk reduction can reward eligible project activity under their own rules.
3. **Project-economy Rewards:** project-linked products, services, commerce, participation, games, and digital experiences create persistent demand and revenue around accountable project activity.
4. **NCU Network Rewards:** reviewed and approved contributions to project formation and development can receive project-linked NCU allocation, while later protocol and application use creates persistent network utility.

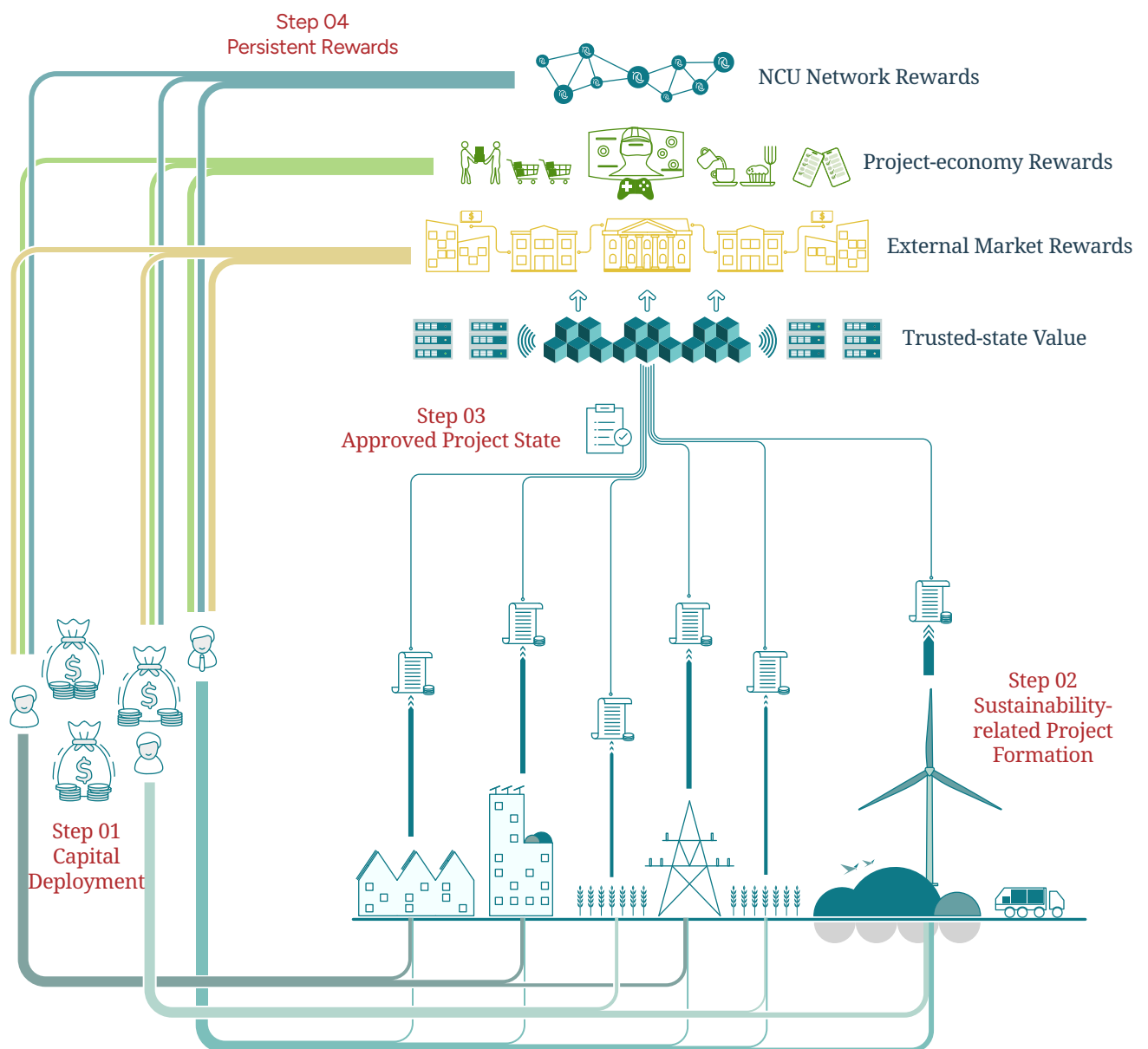


Figure 1: Project-based Economy Model. Each layer reinforces the others. Trusted state can help a project qualify for external rewards and build its own economic activity. Each authorised use adds to the persistent project history, while NCU provides a shared unit for recognition, coordination and participation across the network.

Protocol Architecture: From Evidence to Governed Project State

NCU.fi provides programmable infrastructure that connects reviewed real-world evidence with governed project records, NCU allocation, credentials, claim boundaries and reusable applications. The engineering architecture separates three core smart-contract domains: the Layer 2 (L2) Project Contract, the Ethereum Layer 1 (L1) NCU Allocation Contract, and the Credential Contract Suite. Protocol permissions and NCU.Gen coordinate how these domains interact.

5.1 Solution in One View

The Project Contract records the project's foundational identity and authorised operation history. The Credential Contract Suite validates structured evidence references and lifecycle actions under approved reviewer signatures. The NCU Allocation Contract on Ethereum L1 executes canonical NCU distribution after receiving an authorised allocation instruction. NCU.Gen provides the operating interface across the three domains.

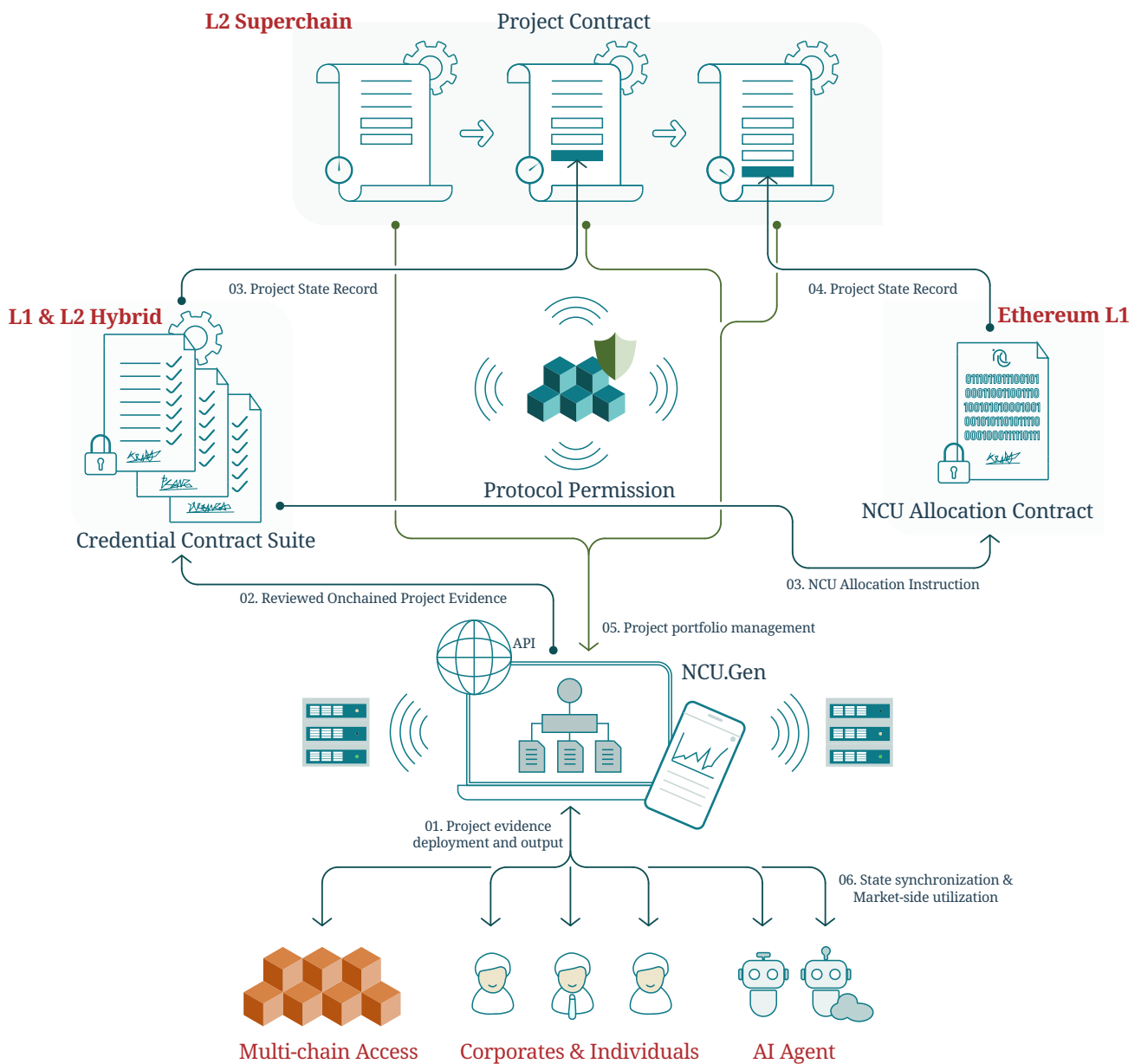


Figure 2: Protocol architecture built on smart contracts and NCU.Gen

5.2 What Enters the System

NCU.fi supports a governed universe of nature-positive and sustainability-linked activity. Initial categories include ecosystem restoration, regenerative production, clean energy, circular systems and resilient infrastructure. New categories can enter when their project boundaries, evidence requirements and external authorities are defined.

Applicable evidence may reference recognised standards, disclosure frameworks, local ecological context, sector-specific metrics, partner methodologies, or project-specific intervention logic. Illustrative references include the International Union for Conservation of Nature (IUCN) Global Standard for Nature-based Solutions, Verra programmes and methodologies, Gold Standard nature activities, Plan Vivo and PV Nature, the Taskforce on Nature-related Financial Disclosures (TNFD) approach and metrics, and the Biodiversity Credit Alliance high-level principles. [7] [46] [47] [48] [49] [50] Napital's Natural Capital Index (NCi) is one example of a project methodology that organises uplift through biodiversity gain, carbon sequestration, air quality, water quality, and soil quality. [51]

These frameworks serve different purposes. NCU.fi records which standard, methodology, metric set, assurance statement or certification applies to each project or evidence scope.

What projects share is a common system boundary:

- who owns, operates, funds, reviews, or makes a permitted claim from the project;
- what activity is proposed, selected, approved, or subsequently executed;
- what purpose, budget category, milestone, and responsible party each Deployment is connected to;
- what environmental, ecosystem-service, product, research, or community results are expected, and how and when they are intended to be assessed;
- what evidence is collected, protected, reviewed, and subsequently updated;
- what outputs and project conditions are monitored over time;
- what allocation, credential, reporting, claim, or market-use pathway an approved record may support.

This common boundary persists throughout the project lifecycle. A Project Contract can receive successive allocation and credential references under the same Project ID, while NCU.Gen maintains detailed evidence manifests, relationships and readable project views.

NCU.fi begins with activity that protects, restores, improves, or regenerates natural value and extends to sustainability-linked real-world activity that can meet the same project boundary. It records the resulting evidence and approved project records so they may support defined allocation, credential, reporting, claim, or market-use pathways where applicable. Sector-specific efficacy, safety, engineering, legal, or financial qualification remains subject to the relevant external authority, standard, issuer, or institution.

5.3 NCU.Gen: Project, Evidence and Coordination System

NCU.Gen is the operating system through which NCU.fi manages projects and connects reviewed real-world information with smart-contract execution. It has five principal functions:

1. Project registration: creates the project record, Project ID, operating profile, responsible organisations, addresses, methodologies and evidence requirements.
2. Evidence preparation and review coordination: organises Deployment and Output materials through de-identification and AI-assisted processing, then routes defined evidence packages to the authorised reviewer.
3. Detailed record and relationship maintenance: stores approved evidence manifests, version history, the persistent project relationship graph, supporting metadata and access policy offchain where appropriate.
4. Contract coordination: submits approved evidence references to authorised Credential Contract modules and initiates permitted allocation or credential workflows.
5. External presentation and interaction: provides project dashboards, institutional views, Application Programming Interfaces (APIs), credential interfaces, and public or partner applications.

NCU.Gen carries operational detail, while the contracts preserve and execute the minimum authorised records required for integrity, accountability, allocation, credential use and independent audit.

During the initial protocol stage, NCU.Gen receives the broadest operational permission set and serves as the primary authorised coordinator. This accountable, centrally coordinated starting point provides a controlled operating environment while project evidence, review practice, audit coverage and dispute handling are established. Reviewer signatures, approved module permissions, multisignature controls, timelocks and event histories provide the governance framework for each action.

5.4 From Reviewed Evidence to an Authorised Record

Project documents, payments, monitoring data and claims may be reviewed by different parties at different times. A verifiable evidence reference allows a bank, reviewer, partner or credential issuer to confirm the approved version used for a specific action.

Personal, financial and commercially sensitive details can be removed, masked or encrypted. AI can classify files, extract relevant fields and flag incomplete or inconsistent evidence. Authorised reviewers remain responsible for judgement and approval.

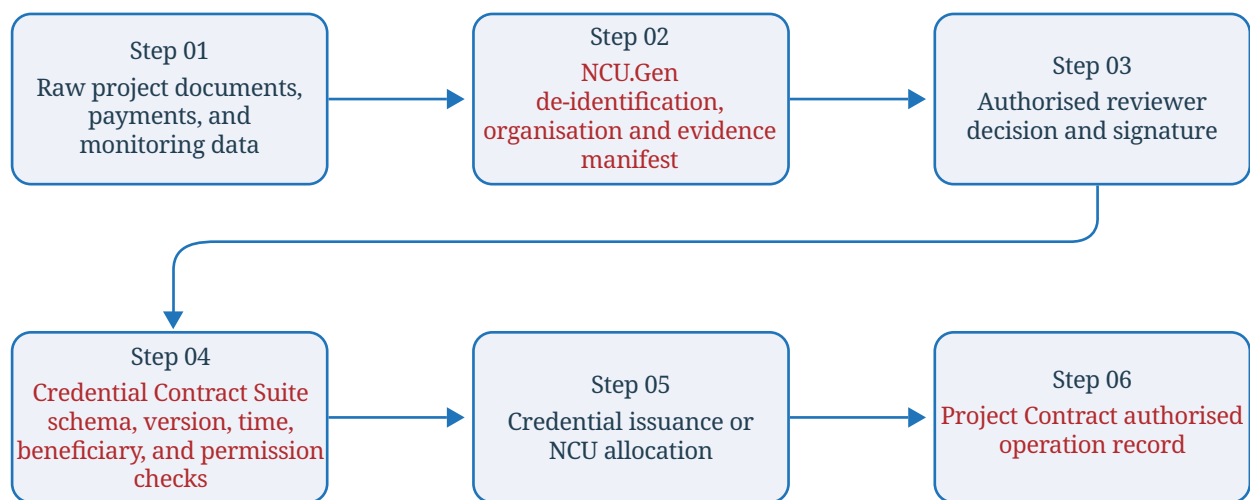


Figure 3: Evidence preparation and authorised action flow

The submitted evidence manifest can include:

- *projectId*
- *evidenceType*
- *evidenceRoot*
- *evidenceVersion*
- *previousEvidenceRoot*
- *reviewerAddress*
- *reviewerSignature*
- *beneficiaryAddress*
- *reviewTime*
- *status*
- *permittedAction*

Detailed source files can remain in encrypted InterPlanetary File System (IPFS), another content-addressed system or controlled storage. The onchain contracts preserve the compact references and authorised results required for verification and audit. Where selective disclosure is required, governed zero-knowledge proofs can confirm defined conditions without revealing the full underlying data, while the related proof reference and authorised result remain attributable to the relevant project action.

5.5 Project Contract: Project Identity and Operation Log

Each eligible project is associated with a Dynamic Project Account generated by Project Contract. It acts as the project-level operation log for one Project ID and preserves the original information required to identify the project and interpret later records.

Record Group	Representative Information
Project identity	Project ID, project type, schema version, and registration time
Project representation	project representative address, operator reference, and authorised modules
Real-world context	jurisdiction, location reference, and controlled site-information pointer
Beneficiary structure	primary or default beneficiary address and class-specific beneficiary addresses
Class 0 — NCU allocation records	allocation ID, beneficiary, Approved Deployment Value, Reward Rate, NCU amount, evidence reference, time, status, and L1 transaction receipt
Class 1 — credential references	credential type, credential contract or ID, holder or subject, evidence version, issuer, time, and lifecycle status
Audit history	caller, transaction reference, previous version, and authorised state-change event

The Class 0 records support a derived Project Contribution Ledger. Additional classes can be introduced through governed schemas for products, monitoring periods, claims or future applications.

5.6 Credential Contract Suite: Evidence Review and Authorised Actions

The Credential Contract Suite receives structured evidence packages and validates the relevant Project ID, evidence scope, evidence version, time, beneficiary or holder, reviewer signature and calling permissions. The underlying evidence may remain in approved offchain storage, while signed references, versions, decisions and authorised state changes are recorded through the protocol. [52]

One evidence framework supports purpose-specific review modules:

Review Path	Reviewed Subject	Authorised Result
Allocation Evidence Review	Evidenced capital, resources, or labor connected to a defined project, purpose, and beneficiary	Approved Deployment Record and instruction to the L1 NCU Allocation Contract
Output Evidence Review	Observed ecological, product, infrastructure, research, or community result	Approved Output Record supporting a credential, report, claim or eligibility update
Credential Lifecycle Review	Issuance, update, use, transfer policy, suspension, revocation, or retirement evidence	Authorised credential lifecycle action

Proof-of-Deployment remains the evidence basis for Allocation Evidence Review. It connects completed Deployment with the relevant Project ID, purpose, responsible party, beneficiary, and expected-result framework.

Later Output evidence updates project quality, credential scope, application access and future Deployment eligibility. This preserves the relationship between timely financial recognition and persistent outcome evidence.

An authorised review can produce two principal protocol paths. An allocation decision instructs the Ethereum L1 NCU Allocation Contract and creates a Class 0 record in the relevant Project Contract. An Output or credential decision updates the applicable credential module and creates or updates the corresponding Class 1 project reference.

5.7 NCU Allocation Contract and Project Participation Record

An approved Deployment follows a defined allocation path. After authorised review, the Allocation Evidence Review Module issues an instruction to the Ethereum L1 NCU Allocation Contract, which applies the current Reward Rate, project and period caps, project-pool rules, authorised-caller controls, and replay protection before distributing NCU to the approved beneficiary. The resulting allocation is then recorded as a Class 0 entry in the relevant Project Contract.

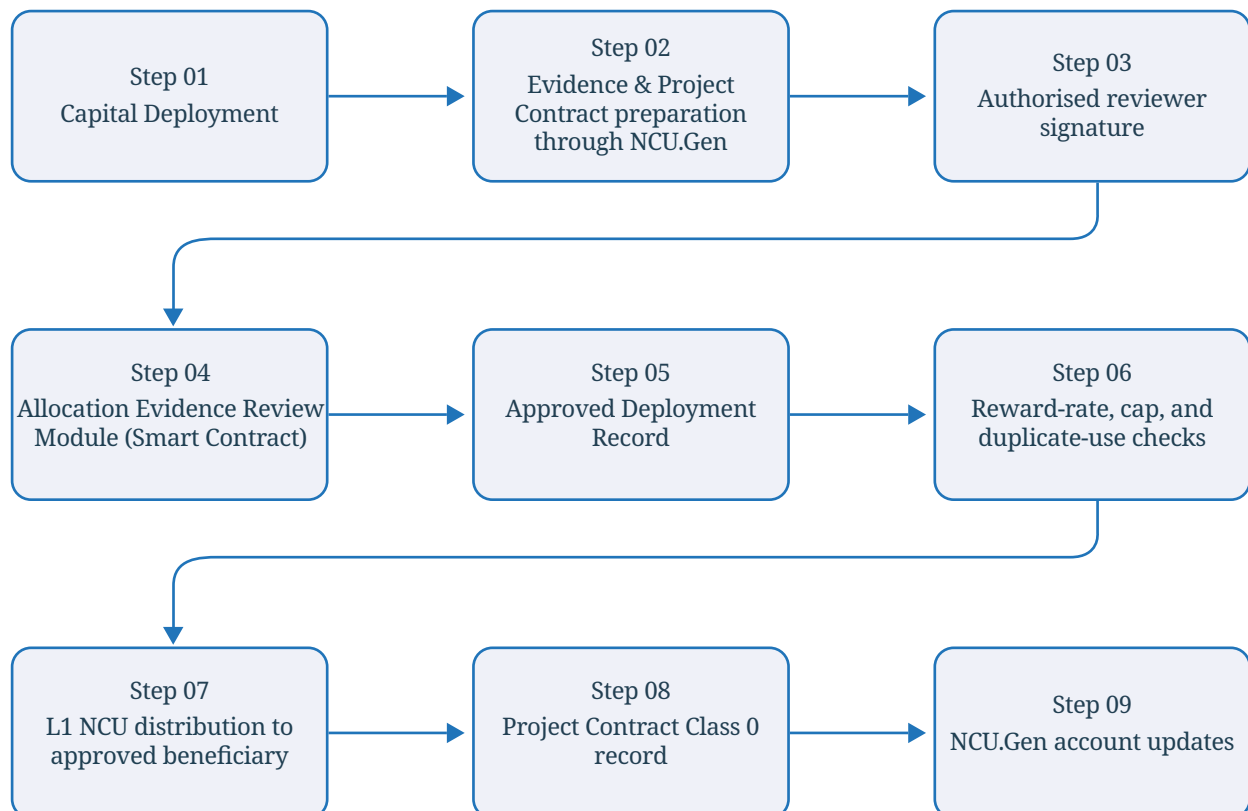


Figure 4: Proof-of-Deployment and immediate allocation flow

For each allocation, the Class 0 record can preserve:

- *deploymentEvidenceRoot*
- *beneficiaryAddress*
- *approvedDeploymentValue*
- *projectFormationRewardRateAtApproval*
- *ncuAllocationUnits*
- *relativeProjectParticipation*
- *approvalTime*
- *L1TransactionReference*
- *allocationStatus*
- *participationStatus*

The Project Contribution Ledger derives its readable participation view from these Class 0 records. Chapter 7 retains the reward framework, project-pool phases and relative-participation explanation.

5.8 Credential Types and Application Policies

Building on the evidence-review and lifecycle modules described in Section 5.6, NCU.fi supports three extensible application credential categories:

Credential Category	Principal Meaning	Transfer and Economic Use
Project status / assurance credential	Expresses project status, review, methodology alignment or eligibility	Governed by the issuer and applicable project or programme rules
Activity / Output / Product credential	Expresses reviewed activity, Output, product batch, origin or claim status	May support transfer or use under the applicable product and market rules
Project participation credential	Expresses defined participation, access, governance or an economic right created through a specific legal and commercial arrangement	Governed by the applicable contract, eligibility, jurisdiction and transfer rules

A Nature Performance Credit, implemented as a transferable Nature Performance Credential, is a specific Activity / Output credential with its own evidence, holder, NCU-position and lifecycle rules. Chapter 8 presents the Taoyuan concept.

Credentials reference the persistent Project Contract while following their own issuance, transfer policy, claim and retirement rules. Class 1 records preserve the corresponding project-level references. Each product, asset or credential follows an explicit application policy. The policy defines the underlying product or right, seller or issuer, settlement route, service and NCU protocol fees, transfer effects and the applicable claim, dispute, revocation and retirement states.

Any financial right is defined by the applicable project-specific credential, agreement, and legal framework.

5.9 Protocol Permissions and Multi-Chain Access

Protocol permissions define the approved project representatives, reviewers, issuers, beneficiary roles, contract modules, administrators and emergency authorities. Initial operation uses NCU.Gen as the primary authorised coordinator under disclosed multisignature, timelock and module-approval controls. The permission model follows a staged path from NCU.Gen-led review to approved independent reviewers and federated assurance, and later to broader network governance for defined protocol parameters. Progress depends on demonstrated project volume, reviewer diversity, audit coverage, dispute capacity, AI-assisted assurance, and network participation. Authorised people and organisations remain identifiable and accountable throughout this transition.

Ethereum L1 preserves canonical NCU supply and allocation execution. An approved L2 or other execution environment can support frequent Project Contract operations, credential interactions, evidence references and application calls. Authorised messages and transaction receipts connect those domains with the relevant Project Contract records. [53] [54]

Chain-neutral Project IDs, evidence schemas, APIs, credential interfaces and event formats support access by enterprise systems, public programmes, finance, commerce and applications.

At a later protocol stage, a Project Contract Factory or Registry may standardise project creation and discovery. A Schema and Policy Registry may publish reusable evidence types, credential scopes, issuer rules, transfer policies and claim boundaries.

5.10 Architecture as One Continuous System

The components operate as one lifecycle. NCU.Gen organises evidence and review; authorised reviewers sign decisions; the Credential Contract Suite validates evidence references and permitted actions; the Ethereum L1 NCU Allocation Contract executes NCU distribution; and each Project Contract preserves the corresponding project-level operation record.

This division of responsibility keeps the engineering architecture clear while supporting credentials, Environmental, Social, and Governance (ESG) instruments, supply-chain records, RWA, commerce and other services described in the next chapter.

Project Infrastructure as a Service and Application Directions

The protocol becomes economically useful when its structure and architecture are delivered as reusable services. NCU.Gen can provide a Software-as-a-Service (SaaS) interface for project and management-accounting workflows, while the smart-contract layer can provide Blockchain-as-a-Service (BaaS) functions for authorised records, allocation and credentials.

6.1 Natural Assets and Sustainable Real-Economy Infrastructure Services

NCU.fi's current portfolio provides an initial operating base across forest restoration, regenerative agriculture, urban natural capital and circular-economy activity. [55] [56] [57] [58] The same architecture can serve other sustainability projects when their methodology, evidence requirements and credential rules are clearly defined.

Potential applications extend from nature-positive infrastructure and sustainable agriculture to the bioeconomy, circular production and new materials. In each case, the project account supplies continuity between responsible investment, production activity, environmental performance and product provenance.

The Project Contract provides time continuity across these sectors. New Deployment records, evidence versions, monitoring periods and Output records can be added without overwriting earlier approved history. A project can therefore support selection, use-of-funds review, ongoing monitoring, periodic reporting, and later applications from the same dynamic project record.

6.2 Institutional Finance, ESG Instruments, Public Programmes, and Empowered RWA

Banks, enterprises, public programmes and financial partners generally need more than a final impact claim. They need to understand whether a project is eligible, how capital is intended to be used, whether relevant milestones have been reached and what evidence supports persistent performance. NCU.fi provides a governed way to retrieve selected approved states while protecting sensitive source materials.

For nature credits and other environmental-market applications, an authorised standard, verifier, issuer or registry can use the project identity, methodology reference, reviewed evidence, credential status and claim boundary. The external system governs the standard, issuance, ownership and retirement of the credit. Its product or transaction rules may also define an NCU protocol fee or another project-specific commercial arrangement for use of the trusted project state.

The Empowered RWA Model adds a callable project-accountability and sustainability-value layer to an eligible structure. Reviewed Deployment can support use-of-funds assessment and milestone tracking; later Output and credential states can support monitoring, covenant review, portfolio reporting and sustainability-linked conditions. An auditable event history allows these assessments to be updated as the project develops.

The Project Contribution Ledger may provide a historical reference for the relative participation established when reviewed project formation occurred. The legal or RWA instrument defines the economic right; the project-specific credential identifies the applicable holder, status or entitlement; and the independently governed agreement determines any receipt and distribution of defined cash flows or benefits. A Ledger ratio becomes an application input where that arrangement expressly adopts it.

This evidence layer may help a financial product recognise more of the value created by accountable sustainability activity. Legal and financial rights remain defined by the relevant instrument, partner, and jurisdiction.

Selected approved states can be exposed through APIs, credentials and smart-contract interfaces to enterprise systems, public programmes, registries and financial infrastructure. External users can verify the applicable project state without rebuilding the full evidence workflow.

6.3 Supply-Chain, Project-Origin Commerce, and Product Lifecycle Records

Project-origin commerce begins with the project or producer account from which a product emerges. The account connects funding, production plans, responsible parties, reviewed activity, outputs, product or batch credentials, purchase, and later fulfilment events. Product information therefore carries a persistent relationship with accountable production and project history.

Digital product passports and product credentials can make selected lifecycle and sustainability information portable across brands, platforms, logistics providers, marketplaces, and customer applications. [41] NCU.fi adds the project-level origin and reviewed-state layer that can sit behind such records.

An agricultural product, such as a verified batch of fruit or honey, illustrates the commercial path:

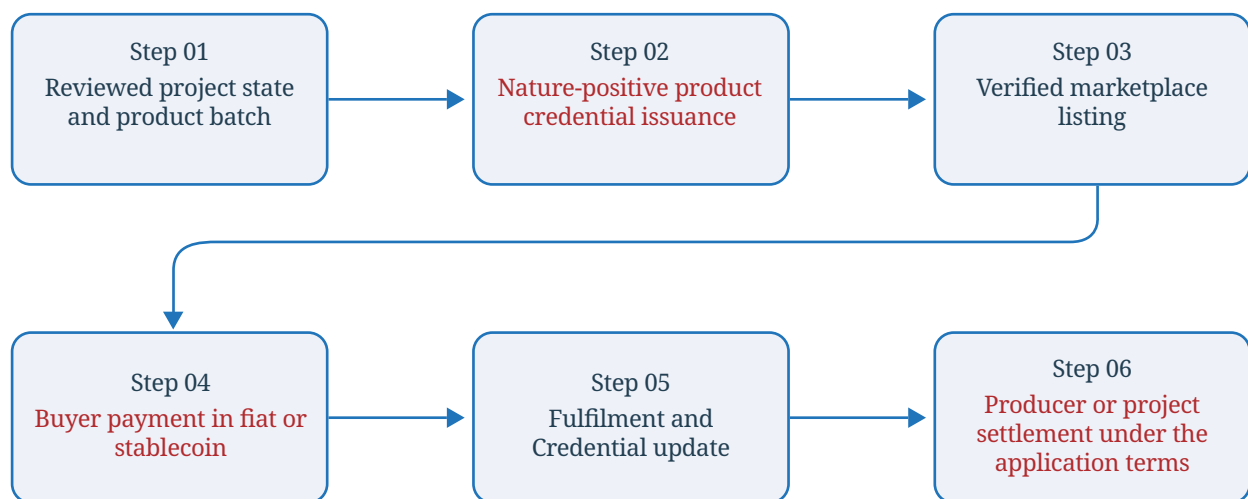


Figure 5: Commercial path for agricultural product in NCU.fi

The product's application policy identifies the seller, settlement method, producer revenue and service fees. It also defines the NCU protocol settlement, any project-specific commercial contribution and whether transfer of the credential carries an associated economic right.

Commerce providers continue to supply discovery, payment, fulfilment and consumer protection. Portable project and product states allow these services to use authorised parts of the same lifecycle record and support more direct producer-to-buyer interaction. The wider environment includes open identifiers, APIs, credential standards and the applicable legal processes.

6.4 Digital Industries, Immersive Experience, and Participation

Digital twins, AI, AR/VR, games, and virtual products represent a longer-term application layer for reviewed real-world project states. A restoration site or productive landscape may support an educational experience whose visible state changes as new monitoring and reviewed Output become available. Users may learn, sponsor or receive a bounded participation credential while the real project continues to generate evidence. [44] [45]

The boundary between representation and evidence must remain clear. Simulated, user-reported, reviewed, and credentialed states each carry a distinct status. Nature-credit status and ownership rights arise through their applicable methodology, issuer, legal instrument, and claim rules. Applications should use the Credential Contract Suite and claim boundaries to define what each digital object represents.

6.5 Participation Spectrum and Boundaries

Participation cuts across multiple legal and economic dimensions. On the consumer side, actions range from discovery and purchase to loyalty engagement; contributions can be sponsorship, volunteer work, or accredited support; and regulated financing includes debt, equity, crowdfunding, and RWA structures. Each of these categories demands distinct permissions, disclosure obligations, and regulatory treatment. A purchase, for instance, not only boosts project demand but also builds an ongoing connection with the project team, whereas a participation credential can serve both as a record of contribution and as an access key.

Ecosystem Economics: NCU Allocation, Project Participation, and Utility

NCU (Natural Capital Unit) is the fungible network-native unit used to recognise approved project formation, preserve a common participation denomination, and support designated protocol and application activity. Its allocation begins with reviewed Deployment; measured outcomes continue through the applicable evidence and credential pathways.

NCU economics connect project formation with the later economic use of trusted project state. The mechanism has two linked levels: project-specific participation is established when completed Deployment is reviewed and allocated, while fungible NCU supports utility across the wider network.

As more projects enter NCU.fi and generate reviewed Deployment, credentials and application activity, they increase both the use of trusted project state and the number of designated protocol interactions. These interactions create demand for NCU through protocol fees, application working balances and, at later stages, role assurance deposits

7.1 NCU Functions in the Economic Model

Within the economic model, NCU performs three connected functions:

1. **Project Formation Reward:** an Approved Deployment receives project-linked NCU allocation.
2. **Project Participation Denomination:** the approved allocation units establish relative participation within that project.
3. **Network Utility:** fungible NCU circulates across designated protocol and application activity.

Project-linked allocation begins when an eligible Deployment is approved. Ecological performance continues through the applicable methodologies, indicators and Approved Output Records, which update project state, credential scope and later eligibility.

7.2 Proof-of-Deployment and Immediate Allocation

Proof-of-Deployment verifies the prior commitment of capital, resources, or labor to a specific project, purpose, responsible party, and expected-outcome framework. Each completed Deployment is submitted and reviewed independently.

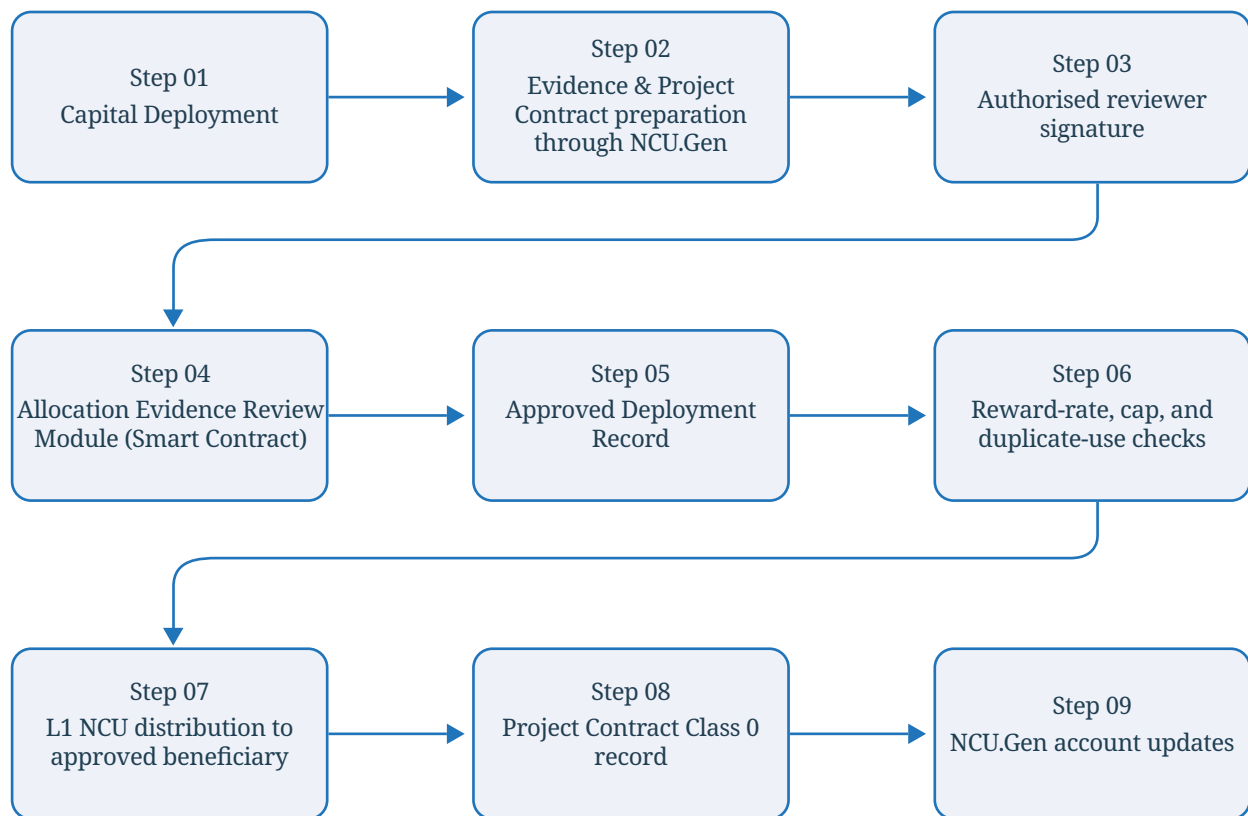


Figure 4: Proof-of-Deployment and immediate allocation flow

Project-pool supply discipline determines how many NCU units each Approved Deployment receives. Final approval completes the allocation and distributes the corresponding NCU to the approved beneficiary. Long-cycle projects may submit successive completed Deployment records, allowing participation to grow as real activity develops.

Final approval completes the ordinary distribution path for an Approved Deployment. Later Output updates project quality, credentials, application scope, future Deployment eligibility and the persistent project economy. Product-specific legal or compliance requirements may apply an approved escrow or hold.

An agricultural project illustrates the timing. Field preparation, delivered inputs, production work and monitoring activity arise before a harvest reaches buyers or an environmental credential becomes eligible for consideration. Each eligible contribution can be evidenced and reviewed as a distinct Deployment event, allowing approved participation to receive NCU allocation during project formation while later product sales, credentials and services build on the same project history.

7.3 Project Allocation Records and Contribution Ledger

Each approved NCU allocation creates a Class 0 record in the relevant Project Contract. These canonical records can be queried to generate a Project Contribution Ledger: a readable project-participation view showing Approved Deployments, beneficiaries, Reward Rates, allocation units, and relative participation established at approval.

Each Approved Deployment receives project-linked NCU allocation units using the Project Formation Reward Rate in effect at approval. The Foundation Reward Rate remains fixed during the initial phase. Across the long-term higher-to-lower reward path, an equivalent Deployment approved in a later phase generally receives fewer units.

The global NCU balance represents fungible NCU currently held by an address and available for transfer or network use. The Project Contract preserves the Class 0 source records, while the Project Contribution Ledger presents the project-specific allocation units and participation established at approval as fungible NCU circulates.

Project-specific credentials and applications may reference the derived Ledger for access, governance, participation programmes or separately constituted commercial arrangements. The applicable credential, agreement and legal framework establish each application's eligible parties, rights and effects.

7.4 Fixed Supply and Project Formation Reward Rate

NCU has a fixed total supply of 2,000,000,000 units. The allocation structure separates project formation, ecosystem growth, contributor alignment, liquidity and treasury resilience:

Allocation Category	Percentage	Token Amount	Distribution basis
Project Allocation Pool	50%	1,000,000,000	Project-linked pool governed by Proof-of-Deployment, Reward Rate rules, cumulative pool usage, allocation velocity, project caps and authorised review. Each approved project allocation is distributed immediately after final approval.
Public Access and Ecosystem Growth	30%	600,000,000	Ecosystem development, partnerships, participation programmes and compliant public or market access.
Team	15%	300,000,000	Contributor alignment through a separate 12-month cliff and 24-month or longer linear vesting schedule.
Liquidity and Treasury	5%	100,000,000	Liquidity operations, treasury resilience, protocol operations and ecosystem continuity.

The Project Allocation Pool develops through three governance phases. These thresholds remain subject to legal review, governance approval, technical implementation and live project data:

Phase	Operating mode	Purpose
Foundation Reward Phase	fixed, published Project Formation Reward Rate for selected eligible Deployment	provide predictable early participation terms while establishing project records, evidence workflows and review practice
Calibration Reward Phase	periodically calibrated Reward Rate within disclosed governance bounds	use observed Deployment quality, review cycles, allocation velocity and network demand to calibrate the later rule set
Protocol Reward Phase	governed rule-based Project Formation Reward Rate	provide transparent and repeatable allocation discipline informed by live operation

The figure 6 presents a conceptual example of one possible long-term Project Allocation Pool and Reward Rate path. An adopted issuance schedule and its later-phase parameters will be calibrated through live Deployment, observed network demand, governance, legal review, and technical implementation. Individual holder vesting and token-unlock schedules are governed separately.

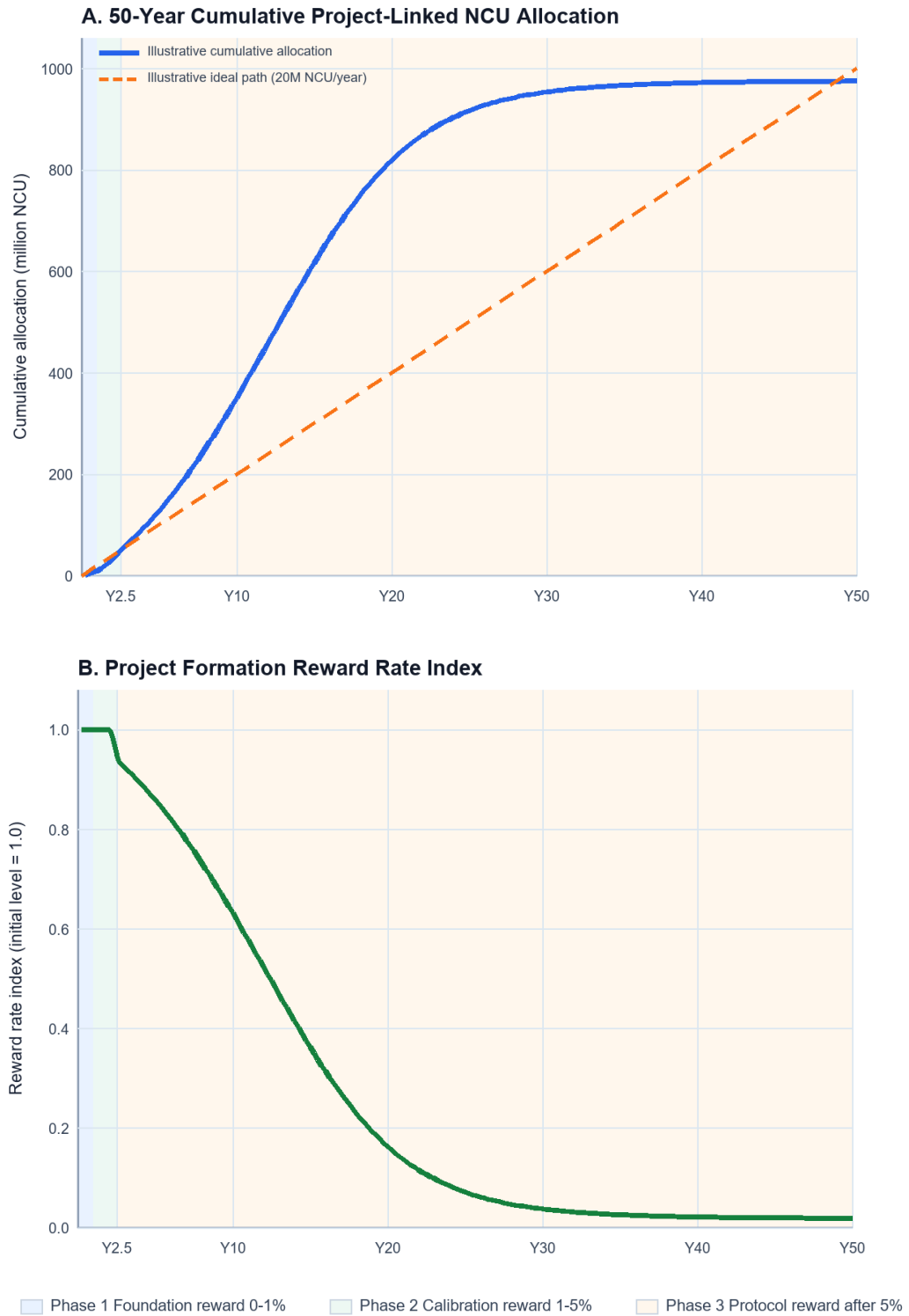


Figure 6: Illustrative 50-Year Project-Pool Allocation and Reward Path

7.5 Where NCU Is Used

NCU utility develops through designated protocol activity and a staged expansion of network responsibility:

Use	Protocol role and stage
Protocol service settlement	each designated NCU.fi state-changing action requires an NCU-denominated protocol fee or an application working balance; relevant actions include credential lifecycle events, verified project or product registration, project-state changes, write-enabled APIs, participation programmes, disputes and review workflows
Application working balances	applications maintain the NCU required for defined protocol operations while offering users familiar payment and account interfaces
Commerce and participation settlement	eligible products, services, digital assets and participation programmes may use NCU at protocol level; user-facing payment may remain available in NCU, fiat or stablecoin
Future role assurance deposits	reviewers, credential issuers or authorised application operators may lock NCU as an economic commitment when role-entry, dispute, appeal and penalty rules are sufficiently developed
Staged protocol governance	NCU may support defined signalling, voting and proposal functions as review, issuer and network responsibilities become more decentralised

Read-only access can remain available without creating unnecessary token friction. A user may pay through a familiar currency while an application performs any required NCU protocol settlement in the background.

NCU protocol fees are distinct from the native gas token required by the relevant blockchain. Published protocol policy defines fee levels, routing and any retention, redistribution or burn treatment as live usage and market conditions become observable.

Future role assurance deposits are separate from the immediate Proof-of-Deployment allocation received by project participants. They give authorised actors an economic commitment to service quality and responsible conduct. Activation requires clear eligibility, evidence, dispute and appeal procedures, together with proportionate rules for release, suspension or penalty.

Protocol governance develops in stages. Early governance uses NCU.Gen-led institutional, multisignature and timelock controls. Later phases may introduce NCU-based signalling and voting for defined network parameters, fees, treasury use, and protocol upgrades as reviewer diversity, audit coverage, dispute capacity, AI-assisted assurance and network participation mature. Scientific methodology, external certification, project eligibility under third-party standards and legally regulated decisions remain with the relevant expert, issuer or competent authority.

Current Application Directions

Part 8 presents current project contexts through which the architecture is being tested against real evidence and market applications.

Application direction	Current or expected use	Project-state connection
Nature-positive projects	project evidence, monitoring, nature-value credentials, and eligible external nature-credit pathways	methodology, baseline, reviewed Deployment, monitoring, Output, verifier or issuer status, claim scope, and lifecycle events
Traceable agricultural products	agricultural production and product batches can connect with a persistent project record	project origin, responsible production, batch identity, evidence, credential, purchase, fulfilment, and updated project history
Project finance and Empowered RWA	eligible productive assets and sustainability-linked projects may connect with financing or RWA partners	operator, use of funds, milestones, evidence, credential status, legal instrument, investor rights, and persistent reporting
Participation and digital applications	public participation, educational experiences, digital twins, AR/VR, games, and developer applications	approved project and credential state, permissions, participation events, and later real-world updates

8.1 One Architecture Across Three Public Project Contexts

Project context	Public direction	Public status	Relevance to the NCU.fi architecture
Bintan, Indonesia	100 ha of forest restoration	2024 Q2 - ongoing	project identity, restoration activity, baseline, monitoring and future credential pathways
Taoyuan, Taiwan	1 ha regenerative farming practice	2025 Q4 - ongoing	agricultural Deployment, field evidence, NCi data, performance credentials and product-origin services
Linkou, Taiwan	3 ha of urban-nature integration	2025 Q4 - ongoing	urban project identity, biodiversity evidence, monitoring, participation and urban-nature services

NCU.fi's public portfolio presents three current project contexts: Bintan forest restoration, Taoyuan sustainable farming and Linkou urban-nature integration. [65] Public updates also report preliminary project reports and NCi data placed onchain for Taoyuan and Linkou. [66] These projects demonstrate how the same project-record and evidence architecture can serve different real-world contexts. The NCU allocation and credential components follow the staged protocol design described in Chapter 5.

8.2 Nature Performance Credit Concept

The Nature Performance Credit ("NPC") is issued through the Credential Contract Suite after the applicable evidence and authorised reviewer approval have been accepted. It is provided to an approved enterprise as a divisible, project-linked Non-fungible Token (NFT) using the ERC-3525 standard. Each NPC is linked to a defined Project Contract and evidence version. It may be divided or transferred while preserving its project relationship, ownership history and evidence provenance. [67]

Each NPC gives its current holder persistent rights within NCU.Gen, including access to current project status, monitoring information, approved evidence, reviewer records and claim history. When an NPC is divided, each resulting NFT retains the same project and evidence relationship with its own Token ID and quantity. When it is transferred, the associated NCU.Gen access rights follow the NFT to the approved new holder.

Upon issuance, NCU.Gen provides an Accounting Evidence Package containing the contract address, Token ID, Project ID, issued quantity, acquisition record, evidence reference and current lifecycle status. This information allows the enterprise to assess and document the NPC for potential balance-sheet recognition, including possible recognition under the International Accounting Standard 38 (IAS 38) where the applicable accounting requirements are satisfied. [68]

Use of the NPC in ESG reporting, sustainability-linked finance or another formal external claim requires the holder to request a Claim Evidence Package through NCU.Gen. The package records the contract address, Token ID, Project ID, authorised claim quantity, evidence version, reviewer signature, current project status, NPC lifecycle status and a registry-verifiable Claim ID. The claimed quantity and updated lifecycle status are recorded in the Credential Registry, allowing banks, auditors, and other authorised users to verify the claim through the registry or a QR-enabled interface. [69]

To activate and continue exercising the rights attached to a NPC, the holder must maintain a protocol-defined Required NCU Balance in its registered NCU.Gen account. The required amount is determined according to the quantity and applicable rules of the NPC.

The Required NCU Balance keeps the holder's access to current project information, NFT transfer functions and Claim Evidence Package requests active. Where the account balance falls below the required amount, the NPC becomes Suspended and these active functions are paused. Ownership of the NFT, historical project information and its audit record remain preserved. Once the required NCU balance is restored, NCU.Gen records the NPC as Reinstated and its active rights may resume.

Where an NPC is transferred, the receiving enterprise must be an approved holder and satisfy the applicable Required NCU Balance before exercising the transferred rights. A Disputed status applies where project evidence, performance data or an existing claim is under formal review.

Depending on transfer, claim and review events, an NPC may move through the following lifecycle statuses:

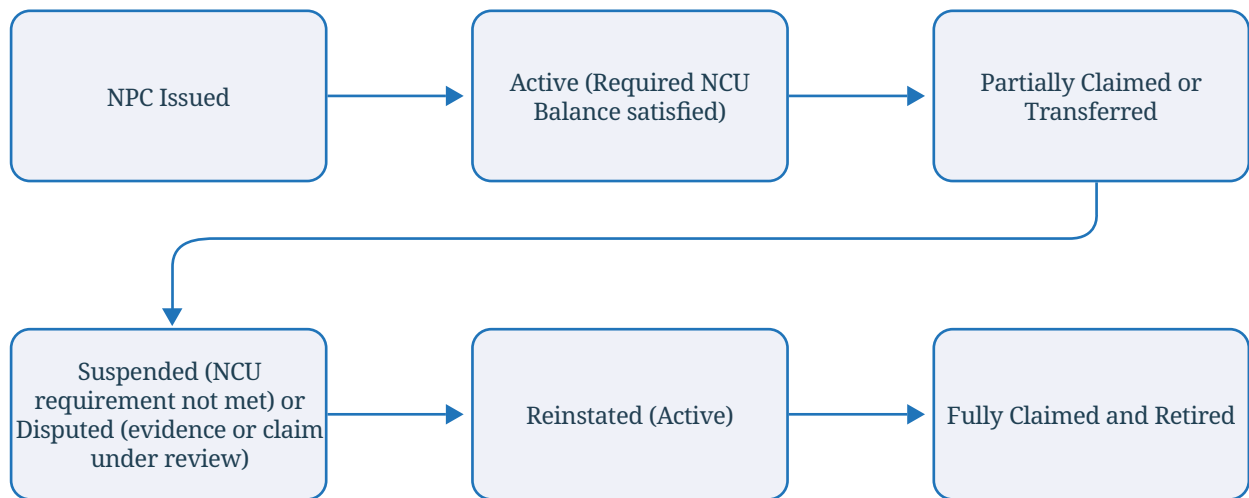


Figure 7: Nature Performance Credit Lifecycle Status

The applicable status and remaining quantity are continuously available through NCU.Gen. A retired, expired or revoked NPC remains verifiable and continues to preserve its historical project information, ownership records and audit trail.

This structure allows an enterprise to hold, divide, transfer and account for the NPC while using NCU. Gen to access current project information and obtain the evidence required for balance-sheet and an authorised ESG or sustainability-linked finance claim.

Risk, Governance, and Regulatory Boundaries

NCU.fi operates at the intersection of sustainability data, project finance, credentials, digital assets, AI-assisted operations, external standards and digital-finance interoperability. Its risk and compliance framework therefore separates responsibilities across protocol-level integrity and permissions, application-level eligibility and controls, and external legal, financial and assurance requirements governed by relevant institutions and jurisdictions. Where an application involves regulated finance, asset rights, transferable economic interests or restricted market access, participation may be subject to KYC/KYB, AML and sanctions screening, participant or investor eligibility, custody and transfer restrictions, and applicable disclosure requirements. NCU.fi can record and apply the corresponding permissions, credential status, claim boundaries and authorised state changes, while legal ownership, revenue rights, financial returns and other enforceable rights remain defined by the applicable contracts, regulated instruments and competent authorities.

Risk	Why it matters	Mitigation
Environmental data and output risk	Natural capital performance and broader environmental performance depend on monitoring data, methodologies, output indicators, field evidence, review quality, and an appropriate comparison with stated expected results.	Third-party certification or assurance where applicable, NCi / local metrics, monitoring records, AI-assisted evidence organisation, expert review, document hashes, version control, and period-based comparison of expected and observed results.
Immediate allocation risk	NCU distributed after final approval can enter circulation before later errors, misrepresentation or fraud are discovered.	Accept completed Deployment only; review payment, purpose, responsible party and evidence; apply project and period caps, duplicate-use checks, reviewer identity and conflict declarations; maintain disputed, superseded or revoked participation status; suspend future Deployment, credential or application eligibility; preserve legal recourse for fraud or material misstatement.
Approved Deployment Value and related-party risk	Related parties, internal costs, in-kind contributions or incomplete price information can raise the approved value above the underlying economic contribution.	Foundation-stage NCU.Gen review; eligible cost categories; payment, contract and delivery evidence; regional or market references; related-party disclosure; project and period caps; recorded valuation basis and evidence references; escalating independent review as reviewer capacity matures.
Deployment quality risk	Immediate allocation recognises reviewed and approved participation during project formation, while later performance determines whether the project continues to deserve market confidence.	Monitoring and Output review update project reputation, future Deployment eligibility, credential scope and application access.
Credential, claim, and application-policy risk	A tradable credential or project product may be misunderstood if its underlying right, transfer effect or commercial treatment is unclear.	Define the underlying right, issuer, transfer rules, claim scope, application policy and dispute, revocation and retirement processes for each application.

Risk	Why it matters	Mitigation
Project participation and financial-right boundary	Class 0 records establish project-linked allocation units, and the derived Ledger presents relative participation; a separate arrangement establishes any economic rights.	Project-specific credentials, contracts, regulated instruments and jurisdictional frameworks define ownership, revenue participation, asset rights, transferability and financial returns.
External standard, reviewer, and issuer dependency	Market acceptance may depend on standards, assurance providers, registries, banks, public authorities, or credential issuers outside NCU.fi.	Align schemas and evidence packages with applicable standards; preserve issuer and reviewer identity; support independent assurance; and distinguish NCU.fi infrastructure from external certification, credit issuance, and legal approval.
Reviewer independence and conflict risk	Project operators, reviewers, credential issuers, and commercial partners may have overlapping incentives.	Identified NCU.Gen-led review under disclosed authority during the Foundation stage, followed by approved independent reviewers and federated assurance as network capacity grows; reviewer eligibility, identity, authority source, scope, conflict declarations, audit trails, multi-party approval where required, and external assurance for higher-risk claims or products.
Broad eligibility and green-claim risk	Expanding from natural capital into wider sustainability applications can encourage vague eligibility or unsupported claims.	Define project category, methodology, expected results, evidence scope, reviewed Output, and permitted claim for each application; distinguish simulated, reported, reviewed, and credentialed states.
Enterprise integration risk	Corporate adoption depends on connection with familiar reporting, procurement, finance, and dashboard systems.	API access, role-based enterprise accounts, exportable evidence packages, dashboard views, Project Contracts, European Sustainability Reporting Standards (ESRS) / TNFD reporting alignment, procurement-ready credentials, and partner integrations.
Nature credit and market application risk	Nature credits, product credentials, procurement, and RWA use cases may have different legal, market, and eligibility requirements.	Product-specific eligibility rules, partner structures, jurisdiction review, usage / retirement status, and market-access gating.
Empowered RWA risk	Nature-related RWA structures may combine project evidence, legal rights, custody, financial exposure, and transfer rules that are outside NCU.fi's direct control.	NCU.fi provides evidence, credential, and claim-governance records only where eligible; legal rights, revenue rights, custody, transferability, and investor protections remain governed by the relevant RWA, partner, and jurisdiction-specific framework.
Digital finance interoperability risk	Stablecoins, tokenised deposits, Central Bank Digital Currency (CBDC)-ready settlement interfaces, and RWA rails create settlement, custody, transfer, and compliance considerations.	Regulated partners where applicable, role-based access, transaction records, legal rights and custody separation, and compliance gating.
L2 / multi-chain state risk	Multi-chain expansion may fragment project, allocation, credential, or claim states.	Chain-portable protocol interfaces, domain-specific authoritative records, Ethereum L1 governance and canonical NCU allocation, an approved execution environment for project and credential activity, chain-neutral identifiers and schemas, governed adapters, cross-chain state checks, and controlled bridge and message policies.

Risk	Why it matters	Mitigation
Token-friction risk	Requiring direct NCU use for every read or user payment could slow institutional and consumer adoption.	Keep read-only access open where appropriate; allow NCU, fiat, and stablecoin user-facing payment routes; use NCU at the protocol layer for designated settlement, state changes and services.
Protocol-governance risk	Token voting can concentrate control or extend into scientific, certification and legal decisions for which token ownership provides no relevant authority.	Introduce NCU-based governance in stages; limit early functions to defined signalling and network parameters; apply multisignature, timelock, quorum and conflict controls; and preserve expert, issuer and competent-authority decisions outside general token voting.
Token velocity and demand risk	Immediate distribution can increase circulation faster than protocol working demand develops.	Require an NCU-denominated protocol fee or application working balance for designated state-changing actions; develop future role assurance deposits; publish fee schedules, fee routing, project-pool allocation and supply data.
Token speculation risk	Market behaviour may detach from project participation, deployment records or credential utility.	Fixed supply, immediate allocation only after final review, the Project Formation Reward Rate, project and period caps, project-pool discipline and allocation-velocity monitoring.
AI operations risk	AI can misread evidence, misclassify projects, overstate risk signals, miss monitoring anomalies, generate weak reports, or amplify broad claims.	AI authority is bounded: final allocation, credential issuance, claim approval and regulated reporting remain subject to authorised human, expert, legal or third-party review. Model versioning, methodology references, audit trails, evidence traceability, risk flags and reviewer overrides support controlled use.

Long-Term Vision: From Static Projects to Agent-Ready Project Economies

Sustainability-project records remain fragmented across contracts, payments, reports, and monitoring systems. A dynamic project account consolidates this history into a persistent, machine-readable state that can be updated without erasing prior approved records.

Several technology transitions now enable this model practical. AI is progressing from content generation towards authorised search, monitoring and execution. [42] [43] Blockchain and tokenisation provide programmable state, credentials and settlement across institutional and open networks. [61] [62] [38] Meanwhile, sensors and structured digital systems increase the observability of physical activity. Their convergence creates the technical basis for software to interpret a governed real-world project state.

Sustainability projects are an important proving ground. The expansion of AI and digital infrastructure is increasing demand for energy, water, minerals, and climate-compatible infrastructure. [63] [64] Meeting that demand requires long-term coordination between capital, technical expertise, local operation and public institutions. A trusted project layer can help the digital economy remain accountable to the physical systems on which it depends.

The development path is an economic and institutional transition:

1. Human-led project economy: people and organisations raise capital, operate, sell, report, advertise, and coordinate through separate online and offline systems.
2. Structured project state: evidence, responsibility, products, credentials, rights, claims, and participation become machine-readable while people and institutions remain the principal decision-makers.
3. Agent-assisted markets: authorised agents help buyers, enterprises, operators, and financiers search, compare, monitor, and perform defined tasks. Verifiable state gains importance as agents evaluate evidence and permissions alongside price, availability, and narrative.
4. Interoperable project economies: commerce, finance, reporting, games, and digital experiences operate over shared project and credential state, allowing each interface to add specialised services to a common history.
5. Agent-ready real-world economy: authorised agents can discover needs, evaluate project state, coordinate purchases and services, monitor performance, and execute permitted actions under explicit identity, authority, payment, claim, privacy, and liability rules.

Human judgement and specialised institutions remain central throughout this transition. Reviewers establish evidence quality; regulators and licensed institutions determine legal and financial validity; commercial service providers support transactions and delivery. Interoperable project state enables their expertise to be applied across the project lifecycle.

In this future, NCU.fi provides the verified project-state layer, while its reward architecture connects external market benefits, project-economy activity, and network participation. NCU coordinates defined forms of access, allocation and network use. The Project Contribution Ledger derives the relative project participation established from Class 0 allocation records, including the stronger relative recognition assigned to earlier project formation across the long-term Reward Rate path.

The future thesis can be expressed concisely: NCU.fi aims to become the verified project and reward layer for an agentic real-world economy.

The path begins with credible nature-positive and sustainability projects, useful enterprise products, reviewed outputs, disciplined participation, and evidence that real demand returns value to persistent project economies.

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Glossary

Term	Plain-language meaning in this whitepaper
Accountable sustainability value	Sustainability-related value connected to a defined project, responsible parties, reviewed evidence, a stated scope and permitted use.
Activity and Output Credential	A credential linked to a reviewed action, contribution, output, product batch, place or monitoring period without conveying control of the project.
Agent-ready project state	Approved project information structured so that authorised software can read its identity, status, permissions, credentials and available actions.
AI (Artificial Intelligence)	Software that can analyse information or perform defined tasks. AI may assist evidence preparation and authorised applications, while review authority remains separately governed.
Allocation Evidence Review	The authorised workflow that validates completed Deployment evidence and creates an Approved Deployment Record and allocation instruction.
API (Application Programming Interface)	A defined interface through which software systems request or exchange selected data and functions.
Approved Deployment Record	The authorised record showing that completed Deployment evidence has passed the applicable review and policy checks.
Approved Output Record	The authorised record showing that Output evidence has passed the applicable review and policy checks.
AR/VR (Augmented Reality / Virtual Reality)	Interactive technologies that overlay digital content on the physical world or create an immersive digital environment.
B2B (Business-to-Business)	Products, services or transactions conducted between organisations.
Bioeconomy	Economic activity using renewable biological resources, processes and knowledge across fields such as agriculture, food, forestry, biotechnology and materials.
CBAM (Carbon Border Adjustment Mechanism)	The European Union mechanism that applies carbon-related reporting and financial obligations to specified imported goods.
Claim boundary	The rule defining what evidence or a credential may support, who may use it, for which purpose and whether it has been claimed or retired.
Content-addressed storage / IPFS	Storage in which content is located through a digital fingerprint. Sensitive information may still require encryption or controlled access.
Credential	A verifiable digital record issued by an authorised party to communicate an approved status, activity, output, participation record or evidence scope.
Credential Contract Suite	The family of authorised modules that validates evidence references, versions, reviewer signatures, beneficiaries, permissions and credential lifecycle actions.
Deployment	Capital, materials, work or another approved activity directed to a defined project purpose or milestone.

Term	Plain-language meaning in this whitepaper
Digital experience	A game, AR/VR experience, digital twin or other interactive application that uses approved project, credential or participation state.
Digital Product Passport (DPP)	A structured digital record that makes selected product identity, composition, origin, sustainability, or lifecycle information available across approved systems.
Digital twin	A digital representation of a real project, place, process or asset that can be updated using real-world information.
Dynamic project account	The persistent digital economic identity assembled from the Project ID, Project Contract records, evidence, credentials and authorised applications.
Dynamic project record	The combined history that develops as new Deployment, monitoring, Output, credential and reporting events are added without overwriting earlier approved state.
Ecosystem gateway	An interface through which an institution, market, application or developer uses selected approved project or credential state.
Ecosystem service	A benefit produced by natural systems, such as clean water, pollination, carbon storage, flood regulation or soil fertility.
ESG (Environmental, Social, and Governance)	A broad set of factors used to assess how organisations manage environmental, social and governance matters.
ESRS (European Sustainability Reporting Standards)	European standards used by in-scope organisations for sustainability reporting under the Corporate Sustainability Reporting Directive.
Evidence manifest	A reviewed index of source files, hashes, evidence types, methodology references, reviewer information, and access rules.
Evidence root / hash	A compact digital fingerprint used to confirm the integrity of an evidence package while underlying documents remain subject to access controls.
EVM (Ethereum Virtual Machine)	The execution environment used by Ethereum-compatible smart contracts.
Global NCU balance	The fungible NCU currently held by an address and available for transfer or network use.
IoT (Internet of Things)	Connected sensors or devices that collect and exchange information about physical systems.
L1 (Layer 1)	A base blockchain that supplies core consensus, settlement and security.
L2 (Layer 2)	A blockchain execution environment designed to process interactions at lower cost while anchoring or settling state to another blockchain layer.
MRV (Measurement, Reporting and Verification)	Processes used to measure results, report them in a defined form and verify them under an applicable methodology or programme.
Natural capital	The stock of ecosystems, species, water, soil, air and other natural resources that supports society and economic activity.
Nature Performance Credit	A transferable Nature Performance Credential issued under defined project, evidence, holder, NCU-position and lifecycle rules.
Nature Performance Credential	A credential expressing reviewed nature performance or contribution evidence under an applicable methodology and issuer policy.

Term	Plain-language meaning in this whitepaper
Nature-positive activity	Activity that protects, restores, improves or regenerates nature, or reduces pressure on natural systems.
Nature-related digital record	A structured digital record of a reviewed project fact, such as a Deployment, environmental Output, credential status or claim use.
NCU (Natural Capital Unit)	The fungible network-native unit used to recognise Approved Deployment, carry approved participation across the ecosystem and support designated project-state, credential, application, future role-assurance, and settlement activity.
NCU Allocation Contract	The Ethereum L1 smart contract that applies authorised project-pool and Reward Rate rules and executes canonical NCU distribution.
NCU.fi	A blockchain-based network that rewards participation in sustainability and connects reviewed project formation with trusted project state and multiple economic applications.
NCU.Gen	The operational system used to register projects, organise evidence, coordinate authorised review and connect users with approved protocol functions.
Output	A reviewed result of project activity, such as an ecological improvement, product, research result or community outcome.
Output Evidence Review	The authorised workflow that validates observed Output evidence for a credential, report, claim or eligibility update.
Programmable project economy	An economic ecosystem in which accountable activity, products, credentials and participation remain connected to persistent project state.
Project Contract	The project-level smart contract operation log that preserves foundational identity, Class 0 allocation records and Class 1 credential references for one Project ID.
Project Contribution Ledger	The readable project-participation view generated from Class 0 allocation records, including Approved Deployment, beneficiaries, Reward Rates, allocation units and relative participation.
Project-Bound Credential	A credential whose meaning depends on the persistent identity, status or recognised control of a project.
Project-Bound NCU Position	An identifiable position that holds or reserves the NCU amount linked to a project-specific credential.
Project-origin commerce	Commerce in which product and lifecycle records retain an authorised connection to the project or producer from which the product emerged.
Project Formation Reward Rate	The rate applied to Approved Deployment Value when calculating project-linked NCU allocation. It is fixed during the Foundation Reward Phase and later follows calibrated, governed rules within the long-term higher-to-lower reward path.
Proof-of-Deployment	The evidence-backed review basis through which completed capital, resources, or labor are recognised as accountable Deployment connected to a defined project, purpose, responsible party and expected-result framework.
Protocol	A shared set of roles, records, state changes and rules that different systems use to interact consistently.
ReFi (Regenerative Finance)	Financial and digital-asset approaches intended to support environmental or social regeneration.

Term	Plain-language meaning in this whitepaper
Relationship manifest / relation root	The reviewed map connecting a project's plans, Deployment, monitoring, Output, credentials, and claims; its digital fingerprint may be anchored onchain.
Relative Project Participation	The relationship between approved NCU allocation units recorded for participants within one project. The fixed Foundation Reward Rate provides predictable early treatment, while the long-term higher-to-lower Reward Rate path gives earlier project formation greater relative participation across phases.
Role assurance deposit	NCU that an authorised reviewer, issuer or application operator may be required to lock under future role-entry, service-quality, dispute, appeal and penalty rules.
RWA (Real-World Asset)	A legally or economically defined real-world asset, right or claim represented or managed through digital infrastructure.
Smart contract	Code deployed on a blockchain that records state and executes predefined rules following an authorised call.
Sustainable economy	Economic activity intended to maintain or improve environmental, social and long-term economic conditions.
TNFD (Taskforce on Nature-related Financial Disclosures)	A framework that helps organisations assess and disclose nature-related dependencies, impacts, risks and opportunities.
Zero-knowledge proof	A cryptographic method for proving that a defined condition is satisfied without revealing all underlying information.

