FLOUR YIELD • EVIDENCE-LED RESEARCH

Basalt, Soil Resilience and Enhanced Rock Weathering

An Evidence-Led Research Dossier for the Flour Yield Ecosystem

Basalt flour • agronomic resilience • enhanced rock weathering • carbon-removal MRV • Balkan Basalt feedstock • FYT context

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1 About This Dossier

Purpose, evidence policy and publication status

This dossier answers four practical questions: what current global evidence supports about basalt flour and enhanced rock weathering; what the supplied evidence establishes about Balkan Basalt feedstock; what remains to be validated before project-specific claims are made; and what role the Flour Yield Token (FYT) can credibly play today.

Publication status. This evidence-led research dossier has been prepared for the Flour Yield ecosystem (Insela UAB, Lithuania; Balkan Basalt Holding B.V., Netherlands). Insela UAB is described in FYT White Paper V15 as a wholly owned subsidiary of Wharf Plan GmbH, Vienna. That commissioning relationship is disclosed for source transparency.
Evidence policy. Every material claim carries a numbered endnote and an evidence level A-F (see Section 23). Company-reported, commissioned, modelled and forward-looking statements are labelled as such throughout. This document is not investment advice, not a MiCA crypto-asset white paper, not a carbon-credit certification and not an agronomic recommendation for any specific field.
Supersession. This dossier supersedes the “Basalt Dossier V5” of August 2025. No conclusion, roadmap, token architecture or citation from that document is carried forward without revalidation in this edition.

Contents

2 Research Scope and Method

This dossier investigates one hypothesis and does not assume its truth.

Core research hypothesis (under test, not a conclusion)

Global agriculture faces an interconnected challenge of soil degradation, erosion, declining soil functionality, climate stress, input dependency and rising production costs. Properly characterised basalt flour, applied under site-specific agronomic protocols, *may* contribute to restoring selected soil functions and improving agricultural resilience while *potentially* enabling durable carbon dioxide removal (CDR) through enhanced rock weathering (ERW). The magnitude and reliability of these benefits depend on mineralogy, particle size, soil properties, climate, application rate, logistics and credible measurement, reporting and verification (MRV). FYT may provide a digital utility layer around eligible ecosystem activities, but it does not itself constitute evidence of agronomic impact, carbon removal, asset backing or financial value.

2.1 Source hierarchy applied

Level	Source	How it is used	Independence
1	FYT Utility Token White Paper V15 (Insela UAB, September 2026)[1]	Authoritative only for the issuer's *current description* of FYT rights, exclusions, supply and regulatory positioning. Internal inconsistencies are flagged, not resolved.	Issuer document
2	Deltares memo 11211751-008-BGS-0001 (2 Sept 2025)[2]; Actlabs Certificate of Analysis A17-02314[3]; FiBL/Skal confirmation of 26 March 2024[4]	Technical context within actual scope: a commissioned literature review; a single-sample laboratory result; a historical input-list confirmation.	External authors; commissioned by or submitted on behalf of Balkan Basalt
3	Peer-reviewed literature, FAO/ITPS, European Commission and EUR-Lex, carbon-registry records and protocols, project publications clearly labelled as project-reported	Primary evidence base for all general scientific, regulatory and market statements. Research updated to 26 September 2026.	Independent, or labelled where not
4	Balkan Basalt Investment Memorandum (October 2024)[5]	Used to *identify* claims requiring verification, never to prove them. Labelled "company-reported" or "legacy projection".	Company promotional document
5	Basalt Dossier V5 (August 2025)[6]	Topic map and visual history only. Not an evidentiary source.	Historical draft

2.2 Evidence classification and claim language

Level	Definition	Permitted wording in this dossier
A	Independently verified ex-post project result	"independently verified" — naming verifier, registry, period and quantity
B	Peer-reviewed field evidence	"observed in a peer-reviewed field study" — naming crop, soil, climate, dose, duration
C	Controlled, laboratory, pot, mesocosm or greenhouse evidence	"observed under controlled conditions"
D	Modelled or scenario evidence	"modelled", "estimated", "scenario-based"
E	Company-reported or commissioned-project evidence	"company-reported", "according to the project document", "not independently verified"
F	Proposed, planned or forward-looking	"planned", "proposed", "intended", "subject to validation/approval"

Visual 12 — Source-quality legend. Tags with this colouring appear throughout the dossier. Levels C–F are never presented as equivalent to A–B. The word "proven" is not used for modelled, commissioned, controlled or project-reported evidence.

2.3 Workflow

Six stages were completed in order: (1) source inventory and conflict audit (conflicts are reported in Sections 15–16, not resolved silently); (2) research update to the cut-off date; (3) a claim ledger for every material quantitative or reputational claim (Section 23); (4) a red-team review of the planned narrative against ten failure tests (possibility-to-proof conversion, missing context on numbers, transfer of third-party project results to Balkan Basalt, theoretical ratios presented as field performance, offtake confused with issuance, token "backing" language, universal-replacement agronomic claims, health-chain shortcuts, regulatory status confusion and asymmetric treatment of negative results); (5) drafting; (6) final factual, legal-language, quantitative, citation and design review.

2.4 Non-negotiable distinctions

Soil degradation ≠ mineral depletion · erosion ≠ degradation ≠ land degradation ≠ "topsoil at risk" · total elemental composition ≠ mineralogy · total nutrient content ≠ plant-available supply · total SiO_2 ≠ plant-available silicon · basalt applied ≠ basalt weathered · basalt weathered ≠ atmospheric CO_2 removed · gross geochemical uptake ≠ net lifecycle CDR · modelled ≠ measured · measured dissolution ≠ issued credit · offtake ≠ issued certificate · company-reported ≠ independently verified · supply commitment ≠ asset reserve backing FYT · FYT payment utility ≠ redemption · ecosystem success ≠ token-holder claim to profits, assets, credits or price appreciation.

3 Executive Research Brief

Ten findings, each with its evidence level. Readers with limited time should read this page and Section 22.

1. **Soil degradation is a documented global pressure, but definitions matter.** FAO and the Intergovernmental Technical Panel on Soils assessed in 2015 that about one-third of the world's land is moderately to highly degraded; FAO's 2019 erosion symposium communicated that more than 90% of soils *could* be degraded by 2050 *if current trends continue*.[7,8] These are assessment-based and communication figures with differing definitions, not model inputs. Institutional assessment
2. **Basalt flour has agronomic effects that are real but conditional.** Peer-reviewed field studies report yield gains of roughly 12–16% (US maize–soybean, 50 t ha^{-1} yr^{-1}),[9] up to about 20% (UK spring oat, temperate, single season)[10] and about 30% on sandy acid soils but no significant gain on silty-clay soils (ryegrass, UK).[11] Responses depend on soil type, baseline pH, dose and crop. Basalt is an amendment, not a replacement for NPK fertiliser, lime or crop protection. B
3. **ERW removes CO_2 in principle and, in specific verified cases, in practice.** The mechanism is well established geochemically.[12,13] Field outcomes are contrasting: a US Corn Belt trial reported a time-integrated 10.5 ± 3.8 t CO_2 ha^{-1} after four years at 200 t ha^{-1} cumulative,[9] whereas a five-year Australian tropical acid-soil trial found a statistically insignificant 0.026 t CO_2 ha^{-1} yr^{-1}.[14] B
4. **Independently verified ERW credits exist but remain small in volume.** Isometric issued 235.53 credits to InPlanet's Serra da Mantiqueira project (Brazil) in December 2024 and a second-period issuance from the same, unreapplied land in May 2026; Puro.earth issued first ERW certificates to Lithos (December 2025) and Mati Carbon (June 2026).[15,16,17,18] The first InPlanet issuance arose from a claimed removal area of about 540 ha out of roughly 1,000 ha treated. A
5. **Theoretical capacity is not field performance.** Deltares' estimate that basalt of Balkan Basalt's stated composition could take up a maximum of 20–25% of its mass as CO_2 (about 4–5 t basalt per t CO_2) is a composition-derived upper bound over an unspecified, multi-decadal horizon, not a measured rate.[2] D
6. **Mineralogy is not established.** Deltares records that the mineralogical composition of the rock was not known to its authors.[2] No quantitative XRD result is in the supplied file. Feedstock-specific weathering-rate claims are therefore premature. Data required
7. **Mine, licence, reserve and capacity figures are company-reported.** Licence validity to 2050, about 220 million tonnes, a 47-hectare mine area, a second production line and annual capacity above one million tonnes appear only in the Investment Memorandum.[5] Deltares separately refers to "approximately 110 million tonnes".[2] None is a classified reserve. E
8. **The EU CRCF has no adopted ERW methodology at the cut-off date.** Delegated Regulation (EU) 2026/285 covers DACCS, BioCCS and biochar; a carbon-farming delegated act was adopted on 10 July 2026; ERW is listed among pathways where methodology work has started.[19,20,21] Voluntary-market protocols (Isometric, Puro.earth) are the operative benchmarks. Regulation
9. **FYT is a utility token with no claim on basalt, credits or revenue.** White Paper V15 presents FYT as a MiCA Title II "other" crypto-asset, notified to (not approved by) the Bank of Lithuania, with a fixed supply of 1,000,000,000 tokens, no redemption right, no stability objective, discretionary and unguaranteed issuer cancellation, and a Green Dividend that belongs to Insela UAB.[1] The one-million-tonne supply arrangement is not a MiCA reserve and does not back FYT. Issuer disclosure

What this dossier does not say

It does not say that Balkan Basalt generates verified CDR (it does not, as at the cut-off date). It does not say that FYT is backed, collateralised, pegged or redeemable. It does not say that basalt replaces fertiliser, lime or pesticides, or that basalt-grown food improves human longevity. It does not say that project success will create token value.

4 The Soil System Under Pressure

The opening context is real and well documented. It is also easy to misstate.

4.1 What the institutional assessments say

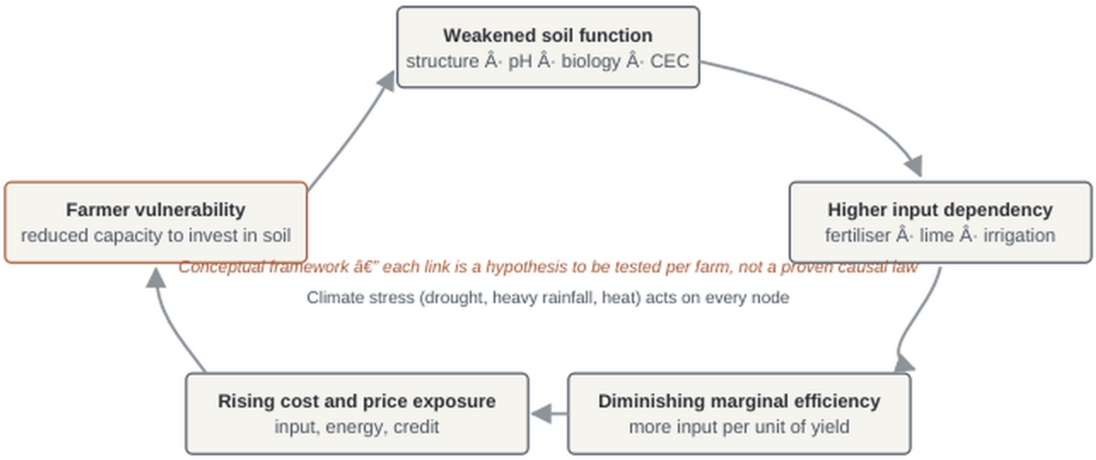
The 2015 *Status of the World's Soil Resources*, prepared by FAO and the Intergovernmental Technical Panel on Soils, concluded that the majority of the world's soil resources are in only fair, poor or very poor condition and that approximately 33% of land is moderately to highly degraded through erosion, salinisation, compaction, acidification and chemical pollution.[7] At the 2019 Global Symposium on Soil Erosion, FAO communicated that the equivalent of one football (soccer) pitch of soil is eroded every five seconds and that the planet is on a path that *could* lead to the degradation of more than 90% of all soils by 2050, with erosion capable of causing crop-yield losses of up to 50% in affected fields.[8,22]

Three safeguards apply to these figures. First, “soil degradation” (loss of soil function), “soil erosion” (physical removal of soil material), “land degradation” (a broader land-system concept) and “topsoil at risk” are related but non-identical concepts measured by different methods; the 33% and 90% figures are not the same metric at two dates. Second, the 2050 statement is conditional on trend continuation and is a communication of assessment risk, not a forecast with confidence intervals. Third, the football-pitch comparison is an illustration for public communication and is not used as an input to any calculation in this dossier.

4.2 Degradation is not mineral depletion

Degradation describes declining soil *function*: structure, water retention, biological activity, nutrient cycling and buffering capacity. It is not synonymous with the exhaustion of mineral nutrients. Many degraded soils retain substantial total element stocks that are simply not plant-available because of pH, fixation, low cation-exchange capacity or organic-matter loss. This distinction matters for basalt: the material may influence pH, cation supply and silicon availability, but it does not address compaction, organic-matter decline or hydrological damage, and it cannot be described as “re-mineralising” a soil without site data showing which functions are actually limiting.

4.3 A feedback loop, stated as a hypothesis



Visual 1 — System map of the soil-pressure feedback loop (conceptual framework). Source: dossier synthesis of FAO/ITPS 2015 and FAO 2019 framing;[7,8] the loop structure is a research hypothesis and not an empirical model.

Stated carefully, the hypothesis is that weakened soil function raises dependence on external inputs, that the marginal efficiency of those inputs can fall on structurally or chemically impaired soils, and that rising costs increase farmer vulnerability, which in turn limits investment in soil restoration. This dossier does **not** claim that mineral fertilisers or crop-protection products inevitably cause declining yields. Their contribution to global food supply is documented, and the loop operates only where soil function is already impaired and where inputs are used to compensate for, rather than complement, that function.

5 Why Farmers Cannot Simply Stop

Any proposal to add a slow-acting mineral amendment must respect the economics of the growing season.

5.1 Time scales do not match

Soluble fertilisers act within days to weeks; liming with carbonates acts within months; silicate rock flour releases cations over seasons to years, with a rate that depends on particle size, mineralogy, soil pH, temperature and water flux.[12,23] A farmer who withdraws conventional inputs before a slow-release amendment has demonstrably altered soil chemistry exposes a full season’s revenue to yield risk. The peer-reviewed field trials that report yield gains from basalt did so *alongside*, not instead of, conventional management.[9,10,11]

5.2 What transition planning requires

- **Baseline soil analysis** (pH, CEC, base saturation, available P and K, texture, organic matter) to identify whether basalt addresses a limiting factor at all.
- **Dose and timing** set per field, not per brochure; peer-reviewed trials span roughly 10 to 50 t ha^{-1}, an order-of-magnitude range with very different logistics and cost.[9,10,11,15]
- **Split or paired treatments** so that any change can be attributed to the amendment rather than to weather or management.
- **Agronomic support** to adjust — not eliminate — fertiliser and lime programmes as measured soil parameters change.
- **Yield-risk management**, including the recognition that some soils (notably silty-clay soils in the UK ryegrass study) showed no significant response.[11]

5.3 Cost realities

Application rates of 10–50 t ha^{-1} involve haulage, spreading and, in most cases, a purchase price. InPlanet has stated publicly that the rates it uses (10–20 t ha^{-1}) would be prohibitively expensive for most growers without carbon finance subsidising the application.[16] This is a project statement, not an independent cost study, but it illustrates why a basalt programme without either a strong agronomic case or an external revenue stream rarely closes on farm economics alone. Section 17 returns to logistics and lifecycle cost.

Implication for the Flour Yield hypothesis

Basalt flour can be positioned only as a *complement* to conventional inputs within a documented transition plan. Any communication that suggests farmers can "stop chemicals" by using basalt would be unsupported by the evidence in this dossier and would expose farmers to avoidable yield loss.

6 Basalt Fundamentals: Chemistry, Mineralogy and Weathering

Composition sets the ceiling. Mineralogy and particle size set the speed. Neither can be read from a brochure.

6.1 What basalt is

Basalt is a fine-grained volcanic rock formed from rapidly cooled lava, conventionally defined by a silica (SiO_2) content of about 45–52% by weight and comparatively high concentrations of calcium, magnesium and iron oxides.[2,12] Its principal minerals are plagioclase feldspar (calcium–sodium aluminosilicate), pyroxene (calcium–magnesium–iron silicate), commonly olivine (magnesium–iron silicate), iron–titanium oxides and, in many basalts, volcanic glass. Rocks with SiO_2 above about 52% are classified as basaltic andesite (52–57%), andesite (57–63%) or dacite (63–70%) under the IUGS total-alkali–silica scheme; they contain less olivine and pyroxene, more feldspar and quartz, and weather more slowly per unit mass.[23]

6.2 Total composition versus mineralogy

A whole-rock chemical analysis (XRF or fusion-ICP) reports total oxides. It does not reveal which minerals host the calcium and magnesium. Lewis et al. (2021) demonstrated across six basalts that carbon-capture potential and the release of plant-nutrient elements depend on mineralogy and physical properties, not on bulk chemistry alone: olivine and glass dissolve orders of magnitude faster than plagioclase, and phosphorus and potassium availability depends on the phases that carry them.[23] Quantitative X-ray diffraction with Rietveld refinement, ideally with electron-microprobe or SEM-EDS confirmation, is therefore a prerequisite for any feedstock-specific reaction-rate claim. **No such analysis exists in the supplied Balkan Basalt file** (Section 16).

6.3 Total nutrients versus plant-available supply

The same distinction applies agronomically. Total K_2O, P_2O_5, CaO and MgO in rock are not equivalent to exchangeable or plant-available K, P, Ca and Mg in soil. Availability follows dissolution, which follows mineralogy, surface area, pH and biological activity. Silicon is the most frequently misrepresented case: total SiO_2 in basalt (roughly half the rock) says nothing about the concentration of monosilicic acid (H_4SiO_4) in soil solution, which is the form plants absorb.[24] Results obtained with soluble silicon fertilisers (e.g. potassium silicate) or foliar silicon sprays cannot be transferred to rock flour.

6.4 Weathering: what controls rate and capacity

Factor	Effect on rate	Effect on capacity	Evidence
Ca, Mg (and Fe) content	Higher base-cation content → more reactive phases available,	Sets the stoichiometric	Peer-reviewed[12,23,25]

Factor	Effect on rate	Effect on capacity	Evidence
	typically faster	ceiling	
Mineralogy (olivine, glass, pyroxene vs plagioclase)	Dominant control; olivine and glass fast, plagioclase slow	None	Peer-reviewed[23]
Particle size / specific surface area	Ten-fold size reduction reported to roughly double rate in two studies; energy cost rises steeply below ~100 µm	None	Peer-reviewed[23,26,27]
Temperature	Higher temperature accelerates dissolution	None	Peer-reviewed[12,26]
Water flux (rainfall, irrigation, drainage)	Controls removal of reaction products and transport of alkalinity	Affects fate of carbon, not stoichiometric ceiling	Peer-reviewed[12,28]
Soil pH and competing acids	Low pH accelerates dissolution of olivine but can divert cations to non-carbonic acid neutralisation	Reduces *net CO_2* capacity where nitric/sulphuric acids dominate	Peer-reviewed[12,14]
Biology (roots, fungi, enzymes)	Can accelerate dissolution and bicarbonate formation	None	Peer-reviewed[2,29]

Table 6.1 — Controls on basalt weathering. Sources as indicated. "Capacity" means the maximum CO_2 that could be neutralised if all base cations were released and balanced by bicarbonate; "rate" means how quickly that happens under field conditions. The two are routinely conflated in promotional material.

6.5 The theoretical ceiling, correctly labelled

Deltares reports a 2012 experimental study relating magnesium content to CO_2 conversion (about 0.087 g CO_2 per g basalt at 8% MgO for magnesite formation) and a German column test of 0.2–0.4 g CO_2 per g basalt (personal communication, unpublished).[2] Its conclusion that basalt of Balkan Basalt's stated composition could reach a *maximum* total uptake of 20–25% by mass (4–5 t basalt per t CO_2) is a stoichiometric upper bound derived from composition and literature. It assumes complete dissolution, full carbonic-acid balance and no losses; it says nothing about how long that would take or what fraction is achievable in soil. D The same memo records field results ranging from 10.5 t CO_2 ha^{-1} over four years down to a statistically insignificant 0.026 t ha^{-1} yr^{-1}.[2,9,14]

7 From Rock Composition to Agronomic Function

Five plausible mechanisms, each with a different strength of evidence and a different set of conditions.

Mechanism	What the literature supports	Conditions and limits	Level
pH buffering / liming effect	Basalt dust raised soil pH by 0.5–1 unit in a UK acid-soil study;[11] decreased acidification is cited by Beerling et al. as a driver of yield response in the US Corn Belt.[9]	Slower and weaker than agricultural lime per tonne; effect scales with dose and reactivity; overshoot possible on already-neutral soils.	B
Slow-release Ca, Mg, K, P supply	Significantly increased Mg and P concentrations in maize and soybean tissue were reported in the US trial;[9] element release depends on host mineral.[23]	Total content is not availability; P and K supply from basalt is modest relative to crop demand.	B / C
Silicon availability	Plant-available Si can reduce abiotic and biotic stress in Si-accumulating crops (review evidence, largely from soluble Si sources);[24] Kelland et al. attribute part of a sorghum yield gain to silicate supply.[30]	Total SiO_2 ≠ monosilicic acid; basalt-derived Si availability requires soil-solution and tissue measurement.	C
Nutrient retention / reduced leaching	Higher pH improves retention of nitrate and phosphate in acid sandy soils (Deltares synthesis); modelling suggests reduced N_2O emissions.[2,31]	Largely modelled or inferred; field N-cycle data sparse.	D
Pest and disease resilience	Si-mediated resistance is documented for soluble Si;[24] no peer-reviewed field study quantifies pesticide reduction attributable to basalt flour.	The legacy dossier's "20–60% pesticide reduction" is unsupported and withdrawn. Basalt does not eliminate pesticides or residues.	C (indirect)

Table 7.1 — Mechanism-by-mechanism evidence. A yield or resilience benefit is plausible under specified conditions; it is not universal, and it is not a substitute for a fertilisation programme.

7.1 Reading a study correctly

Every agronomic statement in this dossier is reported with crop, soil, climate, dose, particle size, design, control, duration and significance where the source provides them (Section 8). Where a source does not provide one of these, the gap is shown as "not stated". Transfer between contexts — tropical to temperate, sandy to clay, 50 t ha^{-1} to 10 t ha^{-1}, one feedstock to another — is never assumed.

Research frontier: food composition and human health

The causal chain from basalt application to soil nutrient availability, to plant uptake, to edible-tissue composition, to dietary exposure, to bioavailability, to any health outcome is **not established** for this or any project. Increased Mg and P in maize and soybean tissue has been reported in one field trial;[9] whether such changes are nutritionally meaningful is a separate question requiring crop analytics and nutrition research. This dossier makes no medical, disease-prevention or anti-ageing claim, and none should be made in ecosystem communications.

8 Agronomic Evidence: What Field Studies Show

Peer-reviewed field and mesocosm studies, disclosed to the level the source permits.

Study	Crop · location · climate	Soil · baseline pH	Feedstock · size	Dose	Design · control · duration	Result (agronomic)	Result (carbon)	Level
Beerling et al. 2024, PNAS[9]	Maize–soybean rotation · Illinois, USA · temperate continental	Mollisol · not stated here	Crushed basalt · fine (p80 <~1 mm reported in source)	50 t ha^{-1} yr^{-1}, 200 t ha^{-1} cumulative	Replicated field plots · untreated control · 4 years	Yield +12–16% ($P < 0.05$); higher tissue Mg, P	10.5 ± 3.8 t CO_2 ha^{-1} time-integrated, cation mass-balance	B
Holden et al. 2024, Sci. Total Environ.[14]	Sugarcane · Queensland, Australia · tropical	Acidic tropical soil	Crushed basalt	50 t ha^{-1} yr^{-1}, 250 t ha^{-1} cumulative	Field · control · 5 years	Not the focus	0.026 t CO_2 ha^{-1} yr^{-1}, statistically insignificant; low pH implicated	B
Skov et al. 2024, PLoS One[10]	Spring oat · north-east England · temperate maritime	Not stated here	Basalt (UNDO supplied) · coarse 0–5 mm	Up to ~40 t ha^{-1} range in source	Field strips · control · 1 season	Yield up to ~20%; no Cd/Ni accumulation in grain	Not quantified	B
Desmalles et al. 2025, Agronomy[11]	Ryegrass · UK · temperate	Sandy and loamy acid soils	Basalt rock powder · 0–5 mm	Multiple rates	Mesocosm/field · control · multi-cut	~30% yield gain on sandy soil; no significant gain on silty-clay; pH +0.5–1	Not quantified	C/B
Kelland et al. 2020, Glob. Change Biol.[30]	Sorghum bicolor · UK glasshouse	Agricultural soil, clay-loam	Basalt · 80% <1,250 µm	100 t ha^{-1} equivalent	Mesocosm · control · 120 days	Yield ~+20%	2–4 t CO_2 ha^{-1} over 1–5 yr (modelled from measurements)	C
Vienne et al. 2022, Front. Climate[32]	Potato · Belgium · temperate	Not stated here	Basalt · 99% <500 µm	50 t ha^{-1}	Mesocosm · control · 99 days	Elevated Ca, Mg in pore water	1.83 t ha^{-1} after 1 yr modelled; not analytically measurable in trial period	C/D
Amann et al. 2020, Biogeosciences[33]	Cropland mesocosm · Germany	Not stated here	Dunite (olivine), not basalt · fine	220 t ha^{-1}	Mesocosm · control · 340 days	—	0.023–0.049 t CO_2 ha^{-1} yr^{-1}; Ni mobilisation observed	C

Visual 4 / Table 8.1 — Comparative study table. Sources as cited; secondary detail (particle size, pH) taken from the Deltares synthesis[2] where the primary article was not reviewed in full for this dossier and marked “not stated here” where unavailable. No result in this table relates to Balkan Basalt feedstock.

8.1 What the pattern shows

Yield responses are positive in several temperate and one tropical context but are neither universal nor large enough to support “replacement” claims. The only long-duration high-dose field trial in an acidic tropical soil (Holden et al.) shows negligible CDR, while a temperate Mollisol trial at comparable dose (Beerling et al.) shows substantial CDR; both are Level B and both are true. The variance between them is the central agronomic and carbon uncertainty for any new site, including any Albanian, Dutch or Italian deployment of Balkan Basalt. Trace-metal accumulation was not observed in the crops studied by Kelland, Beerling and Skov,[2,9,10,30] but Amann et al. report nickel mobilisation from olivine-rich dunite,[33] which is why feedstock-specific testing (Section 16) cannot be skipped.

9 Limits, Variability and Environmental Safeguards

Negative findings and safeguards receive the same prominence as positive evidence.

9.1 Documented limits

- **Soil-type dependence.** No significant yield gain on silty-clay soils in the UK ryegrass study.[11]
- **Slow and uncertain kinetics.** Modelled removals in the Belgian potato mesocosm could not be analytically detected within 99 days.[32] Detection lags of one to several years are normal.
- **Near-zero CDR under some conditions.** Five years of 50 t ha^{-1} yr^{-1} on an acidic tropical soil yielded a statistically insignificant removal signal.[14]
- **Grain-size / energy trade-off.** Finer grinding accelerates weathering but raises electricity use and lifecycle emissions; regional assessments show net benefit is sensitive to this choice.[27,34]

9.2 Trace elements: presence is not the same as hazard

Basalts commonly contain chromium, nickel, cobalt, copper, zinc and lead at tens to hundreds of mg kg^{-1}. The single Actlabs sample reports Cr 310, Co 93, Ni 30, Cu 80, Zn 90 and Pb 9 mg kg^{-1}, with As <5 and Cd not reported in the package.[3] The laboratory's own note states that fusion-ICP-MS values for Cu, Pb, Zn, Ni and Ag are order-of-magnitude estimates and recommends another method (option 4B1) for accurate base-metal concentrations.[3] Whether such concentrations are acceptable depends on speciation (in particular Cr(III) versus Cr(VI)), leachability, application rate, cumulative loading, soil conditions and the thresholds of the applicable product and soil regulations. **The statement "contains no heavy metals" is false for this material and must not be used.** Equally, presence at these levels does not by itself establish that the material is unsafe.

9.3 Safeguards required before field use

Safeguard	Why	Status for Balkan Basalt
Total and leachable/bioavailable Cr (incl. Cr(VI)), Ni, Co, As, Cd, Pb, Hg, Cu, Zn by an appropriate quantitative method	Regulatory limits and crop-uptake risk; fusion-ICP-MS estimates are insufficient	Data required
Natural radioactivity (K-40, U/Th series)	Some volcanic rocks carry elevated activity; product rules may require screening	Data required (Actlabs: Th 0.6, U 0.3 mg kg^{-1} in one sample)[3]
Asbestiform or fibrous minerals where geology warrants	Occupational and consumer safety	Data required; geological setting not documented in supplied files
Respirable crystalline silica and dust management	Worker exposure during grinding, handling and spreading; an SiO_2-rich sample increases the relevance of quartz screening	Data required
Soil pH overshoot and nutrient imbalance monitoring	Repeated high doses on near-neutral soils can reduce micronutrient availability	Site-specific protocol required
Water-body alkalinity and nickel/chromium export monitoring	Hydrological export is part of the carbon pathway and of the environmental risk	Site-specific protocol required

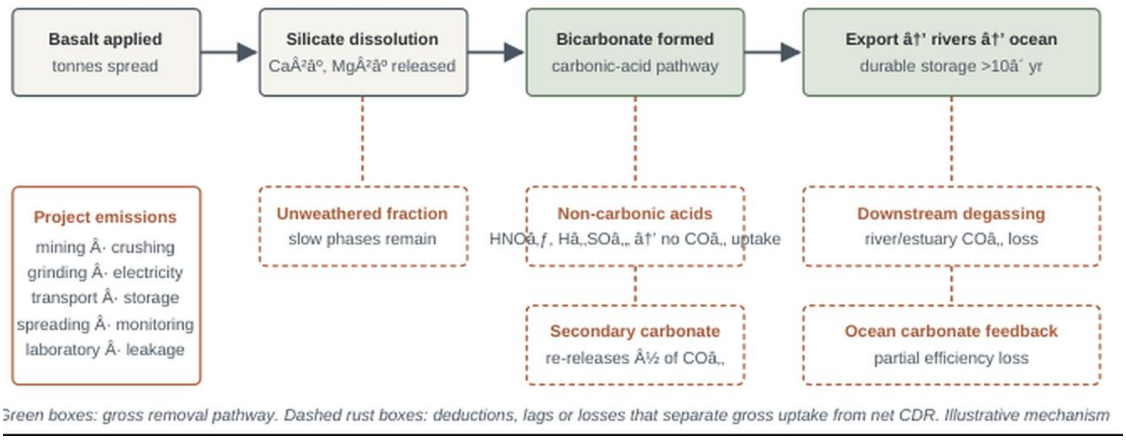
Table 9.1 — Environmental safeguards. "Data required" means no evidence in the supplied file; it is not a finding of non-compliance.

10 Enhanced Rock Weathering: Mechanism and Carbon Pathways

Clear, but not oversimplified. The carbon has to go somewhere, and where it goes determines what can be claimed.

10.1 The reaction

Rainwater equilibrated with soil CO_2 forms carbonic acid. Carbonic acid dissolves silicate minerals, releasing base cations (Ca^{2+}, Mg^{2+}, and to a lesser extent Fe^{2+}, K^+, Na^+) and silicic acid, and converting dissolved CO_2 into bicarbonate (HCO_3^-). In simplified form, for a divalent cation silicate: $XSiO_3 + 2CO_2 + 3H_2O \rightarrow X^{2+} + 2HCO_3^- + H_4SiO_4$.[2,12] The bicarbonate-charge-balanced cations are transported in drainage water to rivers and the ocean, where bicarbonate is stable on time scales of 10^4–10^5 years and longer,[28] or they precipitate as pedogenic carbonate in soil, which returns one of the two CO_2 molecules to solution and halves the removal per cation.



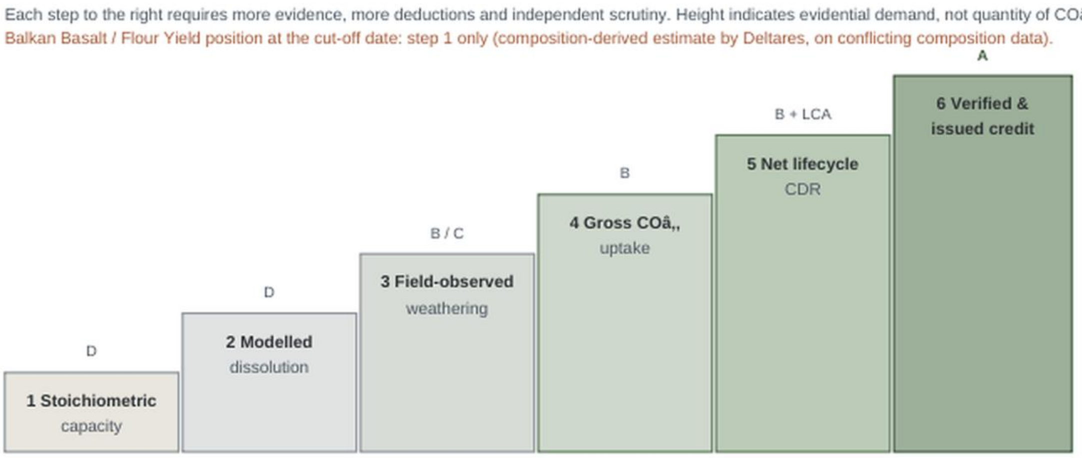
Visual 5 — ERW carbon pathways and possible deductions. Sources: Hartmann et al. 2013;[12] Renforth & Henderson 2017;[28] Lefebvre et al. 2019 (lifecycle);[34] Isometric Enhanced Weathering protocol (deduction categories).[35] Illustrative mechanism; no values shown.

10.2 Where the accounting can fail

Non-carbonic acids. Where nitrification of ammonium fertiliser, sulphide oxidation or organic acids supply the protons that dissolve the rock, cations are released without CO_2 being converted to bicarbonate; the weathering is real but the removal is not.[12] **Secondary carbonates.** Precipitation of $CaCO_3$ in soil is durable but returns half the captured carbon. **Hydrological export and re-release.** Alkalinity carried to rivers can be lost by CO_2 degassing where the water is supersaturated, and ocean carbonate chemistry reduces the long-run efficiency below 100%.[28] **Lag.** Months to years typically elapse between application and a statistically resolvable soil or porewater signal; InPlanet's first crediting period ran roughly 16 months.[16] **System boundaries.** Every registry protocol defines where the removal is counted (soil, porewater, catchment) and which downstream losses are deducted; results from different boundaries are not comparable.

11 From Theoretical Capacity to Verified Net CDR

Six different quantities are routinely called "carbon removal". Only the last one can be sold as a credit.



Visual 3 — Evidence ladder from laboratory/model evidence to ex-post verified credit. Source: dossier framework built on the Isometric protocol structure[35] and the evidence levels defined in Section 2. Levels shown are the minimum evidence class at which each quantity can be stated.

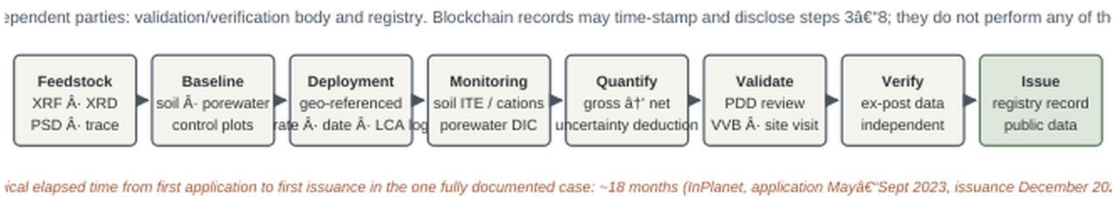
Quantity	Definition	Example in this dossier
1 Theoretical stoichiometric capacity	Maximum CO_2 if all base cations are released and balanced by bicarbonate	Deltares 20–25% by mass for stated Balkan Basalt composition[2] D
2 Modelled dissolution	Rate predicted by kinetic or reactive-transport models under assumed conditions	Vienne et al. 1.83 t ha^{-1} yr 1;[32] Kantzas et al. 6–30 Mt CO_2 yr^{-1} UK potential[36] D
3 Field-observed weathering	Measured cation loss or immobile-element enrichment in soil, or porewater alkalinity	Beerling et al. cation mass balance;[9] InPlanet soil and porewater data[16]
4 Gross atmospheric CO_2 uptake	Step 3 converted to CO_2 after correcting for non-carbonic	Beerling et al. 10.5 ± 3.8 t ha^{-1} over 4 yr[9] B

Quantity	Definition	Example in this dossier
	acids and carbonate fate	
5 Lifecycle-adjusted net CDR	Step 4 minus all project emissions and uncertainty deductions	Required by Isometric and Puro.earth protocols;[35,37] Lefebvre et al. show transport and grinding can consume a large share of gross removal[34]
6 Independently verified, issued certificate	Step 5 verified by an independent body and recorded on a registry	Isometric → InPlanet 235.53 credits, RP1 (May 2023–Sept 2024)[15,16] A

Table 11.1 — The six quantities. An offtake agreement (e.g. Microsoft–InPlanet, >28,500 t, 2026–2028)[38] is a contract to deliver step-6 units in future; it is not itself a step-6 quantity.

12 MRV and Lifecycle Accounting

Isometric's Enhanced Weathering in Agriculture protocol is used here as one important benchmark, not as the only possible methodology.



Visual 6 — MRV workflow from feedstock characterisation to registry issuance. Source: structure of the Isometric Enhanced Weathering in Agriculture protocol;[35] timing from InPlanet/Isometric records.[15,16]

12.1 Requirements a credible protocol imposes

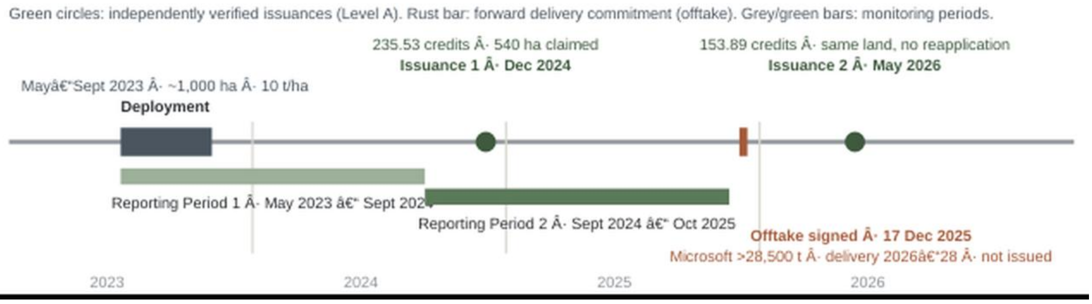
Requirement	What it means in practice
Pre-use feedstock characterisation	Whole-rock chemistry, quantitative mineralogy, particle-size distribution, trace elements and, for immobile-tracer methods, the tracer content of every batch
Baseline and post-application sampling	Georeferenced soil cores before and after application at a density sufficient for statistical power; InPlanet reports higher sampling intensity and improved precision; its July 2026 recap simultaneously states ~1 sample/ha and 1 sample/2 ha while calling the change ten-fold, an internal arithmetic inconsistency in the source16
Control/treatment design	Untreated control areas under the same management; differences, not absolute values, drive the claim
Climatic and field-management records	Rainfall, irrigation, fertiliser (especially ammonium) and lime records, because they alter the acid budget
Soil and porewater measurement	Cations, immobile trace elements, dissolved inorganic carbon and alkalinity; lysimeters or Rhizon samplers for porewater
Productivity and soil-quality monitoring	To detect agronomic harm as well as benefit
Heavy-metal and environmental safeguards	Feedstock thresholds and monitoring of soil and water for Ni, Cr and others
Net-negative GHG statement and LCA	Mining, crushing, grinding, electricity, transport, storage, spreading, monitoring and laboratory emissions deducted; the claim must be net negative after deductions
Uncertainty documentation and deductions	Statistical bootstrapping; credits issued at a conservative percentile
Materiality, PDD, validation, verification, site visits	Project design document reviewed before crediting; independent verification of every reporting period; physical inspection
Public data and registry transparency; no double counting	Underlying data published; unique serialised units; clear ownership of the environmental attribute

Table 12.1 — MRV benchmark requirements. Source: Isometric Enhanced Weathering in Agriculture protocol (current version on the Isometric Registry protocols page as at 26 September 2026);[35] Puro.earth Enhanced Rock Weathering methodology.[37] Requirements are summarised, not quoted; the protocol text controls.

Blockchain and MRV. A distributed ledger can time-stamp documents, record chain of custody and publish disclosures. It cannot measure cation loss, alkalinity or emissions, and it does not replace a validation/verification body or a registry. Any ecosystem communication implying that "on-chain" records prove weathering or CDR would be inaccurate.

13 InPlanet Case Study: Serra da Mantiqueira

A well-documented ERW project with two independently verified issuances from a single basalt application, presented here as a procedural case study rather than a performance benchmark.



Visual 7 — InPlanet case-study timeline. Sources: InPlanet webinar recap, July 2026 (deployment, periods, area, methods);[16] Isometric announcement, January 2025 (first issuance);[15] InPlanet press release of 13 May 2026 via EIN Presswire and Isometric registry project page (second issuance, 153.89 credits);[17] InPlanet press release of 17 December 2025 (Microsoft agreement).[38] Second-issuance quantity is company-reported pending direct registry confirmation by the reader.

13.1 Project facts

Location and crop: Rio Claro, São Paulo State, Brazil; commercial sugarcane (Fazenda São José).16,17
Feedstock and rate: locally sourced basalt rock powder, surface-applied at 10 t ha-1 across approximately 1,000 ha; application began mid-2023 and was completed in September 2023.16 Project-reported
Exclusions: areas reformed for sugarcane replanting were removed from the claim because the geochemical signal became unresolvable; the first issuance rests on a claimed removal area of 540 ha. Operational emissions for producing rock powder for the excluded areas were still deducted.16
Ex-post basis: credits were issued on observed data, not forecast activity.15 A
Design: control and treatment plots; a dedicated monitoring station with 0, 10, 50 and 100 t ha-1 rates alongside the commercial fields.16

13.2 Quantification methods

Reporting Period 1 (May 2023–Sept 2024): Immobile Trace Element approach using neodymium as the geochemical tracer of feedstock and dissolution, at roughly 1 soil sample per hectare.16 The ITE soil mass-balance method is described in peer-reviewed literature.39
Reporting Period 2 (Sept 2024–Oct 2025): Total Cation Accounting approach with sampling intensity reported as increased about ten-fold; the same source states one sample per two hectares, which is arithmetically inconsistent with the earlier ~1 sample/ha figure, which the project reports as materially improving statistical power.16
Porewater validation: lysimeters and Rhizon samplers; calcium, magnesium, dissolved inorganic carbon and total alkalinity measured; treatment–control flux differences showed cation export with a corresponding bicarbonate signal. Measurement precision improved after in-house DIC and autotitration equipment was acquired in 2024.16
Deductions: full lifecycle emissions and statistical uncertainty deductions applied under the Isometric protocol.15,35
Verification: validation, site visit and verification by Isometric completed by end-2024; second verification through the Isometric Certify platform.16,40

13.3 Commercial context

First-issuance credits were delivered to Adyen via ClimeFi;[15] second-period credits were received by ClimeFi.[16] On 17 December 2025 InPlanet announced an agreement with Microsoft to deliver more than 28,500 tonnes of CO_2 removal between 2026 and 2028 from its Brazilian programme, with all credits to be issued under the Isometric protocol.[38] This is a forward delivery commitment. As at the cut-off date the independently verified volume from Serra da Mantiqueira on the public record is roughly 390 credits across two periods; the Microsoft volume is more than 70 times that figure and has not been issued.

Transferable lessons for Flour Yield and Balkan Basalt	What cannot be inferred
Design for verification from day one. InPlanet built its first deployment around the Isometric protocol rather than retrofitting MRV.40 Direct measurement, not modelling alone. Both soil (ITE, then total cations) and porewater (Ca, Mg, DIC, alkalinity) were measured; the two lines of evidence were cross-checked. Controls are non-negotiable. The claim is a treatment–control difference. Without untreated reference areas under identical management, no credit is possible. Sampling density determines what can be claimed. InPlanet reports that increased sampling intensity improved precision and reduced the uncertainty deduction; its July 2026 recap contains an internal inconsistency in the numerical densities it states (see Section 12.1). Characterise the feedstock batch by batch. The ITE method depends on knowing the tracer content of the applied rock; total-cation methods depend on knowing its Ca and Mg content. Neither works with an uncharacterised or variable feedstock. Account for every emission, even on excluded land. Emissions for rock applied to fields later excluded were still deducted. Conservative accounting is what makes the issuance credible. Publish the data. Registry transparency and data sharing with Cascade Climate's Data Quarry allowed external scrutiny.15 Expect exclusions and lag. Roughly half the treated area could not be claimed in the first period, and 16–18 months passed before issuance.	InPlanet's results were obtained with Brazilian basalt, on highly weathered tropical soils, under roughly 1,200 mm of annual rainfall and high temperatures, in sugarcane, at 10 t ha-1, with a specific MRV design, a specific verifier and specific buyers. None of the following can be inferred from that record for Balkan Basalt or Flour Yield: • a CDR rate per tonne or per hectare for Balkan Basalt feedstock in Albania, the Netherlands, Italy or anywhere else; • that Balkan Basalt material would be creditable under the Isometric or Puro.earth protocols, which require feedstock data that do not yet exist for it; • any agronomic response of European crops on European soils; • any commercial value, buyer interest or credit price; • any validity for the Investment Memorandum's 4:1 basalt-to-CO2 ratio, which is a theoretical ceiling, not a result InPlanet achieved (InPlanet's first issuance corresponds to roughly 0.44 t CO2 per hectare over 16 months on the claimed area, i.e. about 23 t of applied basalt per verified tonne of CO2 in that period — a period figure, not a lifetime ratio, and specific to that project). The correct use of the InPlanet record is as a procedural template, not as a performance proxy.

Note on the derived ratio above. 235.53 credits ÷ 540 ha ≈ 0.44 t CO_2 ha^{-1}; 10 t ha^{-1} applied ÷ 0.44 ≈ 23 t basalt per t CO_2 for Reporting Period 1. Computed by this dossier from project-reported inputs;[16] it is illustrative of the gap between theoretical ceilings and first-period verified outcomes and must not be used as a benchmark for any other project.

14 Current ERW Project and Market Landscape

Status as verifiable at 26 September 2026. Actors are not placed in a single "commercially proven" category.

Actor · project	Registry / methodology	Geography · feedstock	Scale (as documented)	Status category · date	Evidence type	Key limitation
InPlanet · Serra da Mantiqueira	Isometric · Enhanced Weathering in Agriculture	São Paulo, Brazil · basalt	~1,000 ha treated; 540 ha claimed; 235.53 + 153.89 credits	Independently issued ex-post credits · Dec 2024, May 2026[15,16,17]	Registry record; project publications	Volumes small; tropical conditions; second-issuance figure company-reported here
InPlanet · Microsoft agreement	Isometric	Brazil	>28,500 t, 2026–2028	Signed offtake · 17 Dec 2025[38]	Company press release	Not issued; delivery risk
Mati Carbon · Chhattisgarh / Seoni	Puro.earth ERW methodology; Isometric v1.2	India · basalt on smallholder rice	717 CORCs (Puro, June 2026); 492.4 t (Isometric v1.2, June 2026)	Independently issued ex-post credits · June 2026[18,41]	Registry listing (Puro project 868685); media report for Isometric figure	Isometric figure not retrieved from registry for this dossier
Lithos Carbon · Mid-West Facility	Puro.earth	USA · basalt	2,362 CORCs	Issued credits, contested · Dec 2025[42]	Registry issuance; independent critique (CarbonPlan)	Underlying data not public; claimed 8.3 t CO_2 ha^{-1} yr^{-1} flux questioned
UNDO · UK and Canada	Puro.earth	UK, Canada · basalt and wollastonite	292,660 t rock over 19,730 ha, 350 farms (company website, Aug 2025)	Field deployment; peer-reviewed agronomic trial · 2024–25[2,10]	Company-reported; Skov et al. 2024 (peer-reviewed)	Deltares (Sept 2025) records no successfully claimed credits at that date; issuance status not confirmed by this dossier
Eion · USA	Isometric	USA · olivine-rich feedstock	Pilot with Perdue reported (~3,500 t)	Announced / pilot-stage · 2025–26[43]	Secondary sources only	No registry issuance confirmed by this dossier
Alt Carbon · India	Isometric	Darjeeling, India · basalt	Microsoft agreement 36,920 t (June 2026)	Signed offtake · June 2026[44]	Media report of company announcement	No issuance confirmed by this dossier
Balkan Basalt / Flour Yield	None	Albania · basalt (composition conflicting)	Supply commitment of 1,000,000 t to Insela (issuer-disclosed)	Announced; no field deployment documented · Sept 2026[1,5]	Issuer and company documents	No characterised feedstock, no trial, no PDD, no verifier

Table 14.1 — ERW landscape with verified status categories. Sources as cited. Inclusion is limited to actors whose status could be tied to a registry record, peer-reviewed paper or dated company publication; the list is not exhaustive. Prices are excluded: the only price signals found are company statements (e.g. Mati ~US\$300 t^{-1})[45] and broker ranges, neither of which is a market quotation.

14.1 Reading the market

Three points follow. First, independently verified ERW volume worldwide remains in the low thousands of tonnes, dwarfed by signed offtakes in the tens of thousands of tonnes per buyer. Second, the two operative standards, Isometric and Puro.earth, have both revised their ERW methodologies since 2024 and continue to do so; Isometric's v1.2 dropped a secondary-validation requirement, and Puro.earth's methodology gained Frontier recognition in June 2026.[41,46] Third, credible actors have attracted public scientific criticism when data were withheld (Lithos), which confirms that transparency is a commercial requirement, not a courtesy.

15 Balkan Basalt: What the Supplied Evidence Establishes

Five documents, read for exactly what they are.

Claim or attribute	Source	Status	What can be stated
Balkan Basalt Holding operates a basalt mine at Spaç, northern Albania, whose output is mainly crushed stone and dike revetment	Deltares 2025, §1[2]	Company-reported	Reported to Deltares by the company; consistent across supplied documents; not verified against licence or land records
Whole-rock chemistry of one crushed-rock sample: SiO_2 61.09%, Al_2O_3 12.68%, Fe_2O_3(T) 9.23%, MgO 3.13%, CaO 7.00%, Na_2O 1.59%, K_2O 0.17%, TiO_2 0.605%, LOI 3.07%; Cr 310, Co 93, Ni 30, Cu 80, Zn 90, Pb 9 mg kg^{-1}	Actlabs Certificate A17-02314[3]	Documented (one sample)	Valid for the submitted material only; the certificate is undated on its face; sample provenance within the deposit is not recorded; base-metal values are laboratory-flagged as order-of-magnitude
Whole-rock chemistry reported as "extracted at a depth of 35 m": SiO_2 48.8%, CaO 9.83%, MgO 6.62%, Fe_2O_3 14.01%; Ni <0.01%	Deltares 2025, §5, "data provided by Balkan Basalt Holding"[2]	Company-reported	No laboratory certificate supplied for this composition; Deltares states within-mine variation is unknown
Mineralogical composition	Deltares 2025, §5[2]	Data required	"Not known to us" — no quantitative XRD in the file
Product "Basalt Dust" of Titan Groep B.V. listed under EU organic legislation and the Dutch Input List	FiBL/Skal confirmation, 26 March 2024[4]	Historical / expired	Valid until 31 December 2024 only; issued to Titan Groep B.V., not to Balkan Basalt; the document does not identify the geological source of the product; it is an input-list listing, not a certification of the material's composition or of EU-wide fertilising-product conformity
Permits and certificates valid to 2050; 47 ha mine area; 220,224,540 t "reserve"; production ~360,000 t/yr now; second line +60,000 t/month; >1,000,000 t/yr combined capacity; profitable; "one of the largest" European deposits	Investment Memorandum, Oct 2024[5]	Company-reported	No licence, geological report, competent-person statement, audited accounts or port documentation supplied. Deltares separately cites "approximately 110 million tonnes available" — the two company figures conflict
Theoretical CO_2 uptake of 20–25% by mass; 4–5 t basalt per t CO_2	Deltares 2025, §7[2]	Modelled / estimated	Upper-bound concept from composition and literature; not a measured or field value; computed on the 48.8% SiO_2 composition, not on the Actlabs sample
Purchase & Supply Agreement / consignment of 1,000,000 t agronomy-grade basalt flour for Insela UAB	FYT White Paper V15[1]	Issuer-disclosed	Underlying agreement not supplied; terms known only through the issuer's summary; expressly not a MiCA reserve

Visual 8 — Balkan Basalt evidence-status table. Status vocabulary: documented · company-reported · expired · conflicting · data required. Sources as cited.

15.1 The two chemical analyses, side by side

Oxide (wt %)	Actlabs A17-02314 — submitted sample[3]	Composition supplied to Deltares — "35 m depth"[2]	Observation
SiO_2	61.09	48.8	12.3 percentage-point gap; 61% is outside the basalt range and within andesite/dacite
CaO	7.00	9.83	Deltares composition richer in Ca
MgO	3.13	6.62	Deltares composition has twice the Mg
Fe_2O_3(T)	9.23	14.01	Deltares composition richer in Fe
CaO + MgO (capacity proxy)	10.1	16.5	Stoichiometric CO_2 ceiling differs by roughly 60% between the two
Ni	30 mg kg^{-1} (fusion-ICP-MS, order-of-magnitude)	<0.01% (= <100 mg kg^{-1})	Not contradictory, but neither is a quantitative base-metal determination
Method / provenance	Fusion-ICP (majors), fusion-ICP-MS (traces); certificate undated; one sample; provenance not recorded	No certificate; method, date and sampling unknown	Neither analysis is traceable to a documented sampling location

Visual 9 — The two supplied analyses, displayed separately and not blended. The values are not averaged and no "preferred" profile is selected. They may represent different samples, depths, lithologies, alteration zones, dates or analytical contexts. Only a documented sampling campaign can resolve which, if either, represents saleable production. If the Actlabs sample is representative of any production stream, that stream would be more accurately described as an intermediate volcanic rock than as basalt, with correspondingly lower Ca+Mg reactivity per tonne.

16 Balkan Basalt: Evidence Gaps and Feedstock Qualification

What has to exist before any project-specific agronomic or carbon claim can be made.

16.1 Feedstock qualification programme (Gate 2 of the roadmap)

Test	Purpose	Standard or method (indicative)
Georeferenced sampling across benches, depths and lithologies, with chain of custody	Establish provenance, resolve the SiO_2 conflict, quantify deposit variability	Documented sampling plan; duplicates; certified reference materials
Whole-rock XRF (majors, LOI) on each composite	Classification (TAS), Ca+Mg budget, batch specification	Accredited laboratory; report with method and date
Quantitative XRD with Rietveld refinement; SEM-EDS or microprobe where needed	Mineral hosts of Ca, Mg, Ni, Cr; glass content; reactive-phase fraction	Rietveld with amorphous-content determination
Particle-size distribution and specific surface area of the 0–4 mm by-product and any ground fractions	Rate modelling; dust risk; energy trade-off	Laser diffraction / sieving; BET
Total trace elements by quantitative method (4-acid or peroxide fusion with ICP-OES/MS): Cr, Ni, Co, As, Cd, Pb, Hg, Cu, Zn, Tl, V	Replace order-of-magnitude values; regulatory comparison	Actlabs' own recommended option (4B1) or equivalent
Cr(VI) speciation; leachable/bioavailable fractions	Toxicity relevance; soil and water risk	Alkaline digestion for Cr(VI); DIN 19730 / EN 12457-type leach tests
Natural radioactivity (gamma spectrometry)	Product-safety screening	K-40, Ra-226, Th-232 activity concentrations
Fibrous-mineral and respirable crystalline silica screening	Occupational safety; higher priority if silica-rich lithologies are present	PLM/TEM for fibres; XRD for quartz in respirable fraction
Batch variability protocol and specification sheet	Repeatable MRV inputs; commercial specification	Per-lot certificate against defined limits

Table 16.1 — Representative feedstock campaign. Methods are indicative; the applicable registry protocol and product regulation define the binding requirements.

16.2 Documentary gaps (Gate 1)

- Mining licence or concession, its holder, scope and expiry; environmental permits for extraction and processing.
- Corporate structure and chain of title between Balkan Basalt Holding B.V. (Netherlands) and the Albanian operating entity.
- Geological resource report under a recognised classification standard (e.g. PERC, JORC, UNFC) with competent person and effective date; without it, tonnage is a "company-reported geological inventory".
- Audited production data supporting current output and the second production line.
- Port, haulage and processing energy data supporting the Memorandum's logistics and "low-emission" statements.
- The Purchase & Supply Agreement and custody framework summarised in White Paper V15.
- Any current product listing, national registration or conformity assessment for the flour as a fertilising product (the 2024 FiBL confirmation has expired and names a different company).

Consequence

Until Gates 1 and 2 are closed, no statement about Balkan Basalt's weathering rate, CDR potential per tonne, agronomic performance, regulatory compliance or reserve life can be made in any Flour Yield communication other than as "company-reported" or "data required". The Deltares 4–5 t basalt per t CO_2 figure should not appear in ecosystem materials without the qualifiers used in Section 6.5.

17 Supply Chain, Logistics and Lifecycle Considerations

A tonne of rock is only a removal if moving and grinding it costs less carbon than it captures — and if someone pays for the difference.

17.1 Lifecycle emission sources

Lifecycle assessment for ERW must include mining (diesel, blasting), crushing and grinding (electricity; the dominant term at fine grain sizes), transport from quarry to port to farm, storage, spreading, monitoring travel and laboratory analysis, plus any leakage such as displaced land use.[34,35] Lefebvre et al. (2019), assessing São Paulo State, found that transport distance and grinding energy can consume a large fraction of gross removal, and that the carbon intensity of the electricity grid is decisive.[34] Rinder and von Hagke (2021) show, in a regional assessment, that the optimum particle size is a trade-off between weathering rate and grinding energy rather than "as fine as possible".[27]

17.2 What is specific to Balkan Basalt

- **By-product fines.** Deltares notes that the 0–4 mm fraction is a by-product currently considered of no economic value.[2] Allocating mining emissions to a by-product rather than to the primary aggregate product is an LCA methodological choice that the registry protocol will govern; it cannot be assumed to be zero.
- **Coarse material weathers slowly.** ERW literature focuses on particles below ~100 µm; field studies using 0–5 mm material exist (Skov et al.; Desmalles et al.) but report slower or unquantified carbon outcomes.[2,10,11] Grinding to ERW-relevant sizes adds cost and emissions that the Memorandum does not model.
- **Geography.** Deltares identifies northern Albania's warm, wet climate as favourable to weathering rate.[2] Application near the mine (as InPlanet does in Brazil) minimises transport; export to the Netherlands or Italy introduces sea and road legs whose emissions must be counted against removal.
- **Port and haulage claims.** Capacity and "short-haul" statements are company-reported.[5] E

17.3 Cost signals, clearly labelled

The Investment Memorandum states a cost price of €4.43 per tonne and a basalt-flour sales price of €5 per tonne, and assumes carbon credits sell at €400 per tonne with 50% pre-sold before projects start.[5] These are legacy company projections from October 2024. They are not forecasts endorsed by this dossier, not independently verified and not current market quotations; no verified ERW price series exists. They are reproduced only to make explicit that the Memorandum's carbon economics rest on a price assumption and a 4:1 mass ratio, neither of which is supported by field evidence (Sections 6.5 and 13). Legacy projection

Legacy scenario box — Investment Memorandum assumptions (not adopted)

Assumed: 1 t CO_2 per 4 t basalt; €400 t^{-1} CO_2; 50% pre-sale; annual rollout 2026–2050; "inexhaustible" credit supply. Observed in the one fully documented verified project: ~23 t basalt per verified t CO_2 in a first 16-month period under tropical conditions (Section 13), with credit prices known only from company statements. The gap between these two pictures is the evidence gap this dossier documents.

18 The Role of FYT in the Flour Yield Ecosystem

A proportionate account of what the token is, according to its issuer, and what it is not.

18.1 Current status as described in White Paper

Attribute	Issuer's current description[1]
Issuer	Insela UAB, Lithuania; described as a wholly owned subsidiary of Wharf Plan GmbH, Vienna
Classification	MiCA Title II crypto-asset other than an asset-referenced token or e-money token ("utility token"); not intended to be an ART, EMT or financial instrument
Regulatory step taken	Crypto-asset white paper notified to the Bank of Lithuania under Articles 6–8 MiCA. The White Paper itself states it is "notified to, but not approved by" the competent authority. Notification is not endorsement, approval or authorisation[47]
Supply	1,000,000,000 FYT minted at genesis; total supply fixed and capped; no additional minting contemplated under the current design
Chain and deployment	ERC-20-compatible contract on Hyperliquid / HyperEVM. Inconsistency flagged: the document states in one place that FYT "is deployed" and "live", and in another that the mainnet contract address is "to be published upon final deployment". No current official confirmation of deployment, admission to trading or market availability was located by the cut-off date; this dossier therefore does not state that any of these has been completed
Rights excluded	No ownership, profit-sharing, dividend, interest, repayment, redemption or delivery right; no claim to basalt inventories, carbon-removal units, certificates, project revenues or partner assets
Stability	No stability objective; the issuer makes no commitment to maintain market value; "this crypto-asset may lose its value in part or in full"
Marketplace	Holders may *spend* (not redeem) FYT for basalt flour and other products at a variable FYT price reflecting prevailing market conditions; deliveries to merchants at market rates at the time of delivery. No fixed ratio of FYT to basalt exists

Attribute	Issuer's current description[1]
Green Dividend	A dividend or corporate distribution Insela UAB *may* receive from Balkan Basalt or another partner; belongs exclusively to Insela; not a dividend on FYT; not paid, segregated or administered for holders; no minimum, frequency or schedule
Acquisition and cancellation	Insela may, at the separate discretion of its management body, buy FYT on the secondary market and permanently cancel it. This is discretionary, not guaranteed, not formula-based, not tied to Green Dividend, basalt or carbon quantities or prices, not at any target price, and may be modified, suspended or discontinued. It creates no price or return entitlement
Possible ART path	A stated forward-looking intent to *explore* authorisation as a basalt-referenced ART under Title III. Non-binding; subject to supervisory authorisation and an approved ART white paper; not part of FYT's current status
Governance	White Paper wording refers to "governance polls", "voting weight" and "future governance modules" as community features; it also states that FYT confers no voting rights. This dossier reproduces both statements and attributes no governance right beyond the exact White Paper text

Table 18.1 — FYT status per issuer. Source: FYT Utility Token White Paper V15.[1] The White Paper controls; this table is a summary and not a substitute for it.

18.2 The one-million-tonne supply arrangement

White Paper V15 describes a Purchase & Supply Agreement under which Balkan Basalt earmarks and holds on consignment 1,000,000 tonnes of basalt flour for Insela, with payment obligations deferred and a contract hash / IPFS reference to be published.[1] In substance and per the issuer's own text: this is an operational supply allocation, **not a MiCA reserve**; it does not back or stabilise FYT; no FYT represents a fixed quantity of basalt; title and release mechanics depend on the underlying agreement, which was not supplied; and publication of a document hash demonstrates only the existence and integrity of a document, not asset ownership or any token-holder right. The White Paper's own use of the label "Basalt Reserve" for this arrangement, while simultaneously disclaiming reserve status, is an internal terminology risk that the issuer should consider addressing.

18.3 Ecosystem functions: current and planned

Function	White Paper description[1]	Status label
Payment for eligible products or services	Medium of exchange for basalt flour, extra virgin olive oil and other "GreenFi" products in participating shops, including the Flour Yield Online Shop and the TarCasso Marketplace, at variable prices	Issuer-described; availability depends on deployment status (flagged above)
Access, discounts and loyalty	Loyalty discounts, early-access sales, tiered access via optional utility locking with no yield	Issuer-described / planned
Community and activity rewards	Referral rewards, merchant-onboarding rewards, "verified environmental participation" rewards from allocated supply	Planned, subject to programme rules
Soil-health and project-data services	Access key to soil-health dashboards, farm onboarding kits, educational content; development of MRV and environmental-transparency services	Planned, subject to validation — no such data exist yet for Balkan Basalt
Provenance and transparency records	Publication of aggregate kilograms of basalt made available (a "non-redeemable reference"); NFT certificate per basalt deployment; on-chain disclosure of cancellations	Planned / partly described; provenance records do not prove weathering or CDR
Support for merchant, farmer, research or pilot participation	Green Growth Allocation Policy may fund pilots, logistics, research and onboarding from Insela's corporate resources	Discretionary corporate policy; no holder entitlement

Table 18.2 — FYT functions. "Planned" functions are labelled as planned. Holding FYT does not grant carbon credits, offset rights, ownership of basalt, project governance rights beyond the White Paper wording or any share in a Green Dividend.

18.4 Evidence-integrity rule for FYT communications

The token is a utility and payment instrument around an ecosystem whose environmental claims are, at the cut-off date, unvalidated for the specific feedstock. The workable rule is therefore: **only verified or clearly labelled project data may enter FYT-facing dashboards, provenance records or communications** (Gate 8, Section 21). Third-party results — InPlanet's issuances, Beerling et al.'s field trial, Deltares' theoretical ceiling — may be cited as context with their labels, but not presented as attributes of FYT, of Balkan Basalt or of the Flour Yield ecosystem. The legacy formulations "intrinsic asset floor", "carbon floor credits", "FYT backing claim", "collateralised by impacts" and smart-contract "minting" on soil or carbon outcomes are withdrawn and should not reappear in any channel.

19 Regulatory Context: MiCA, CRCF and Fertilising Products

Three regimes, three different verbs: notified, certified, conformity-assessed. They are not interchangeable.

19.1 MiCA — Regulation (EU) 2023/1114

For a crypto-asset other than an ART or EMT, the offeror must draw up, notify and publish a crypto-asset white paper (Articles 6–9); the competent authority does not approve it, and the white paper must state that it has not been approved.[47] Holders of such tokens have a right of withdrawal within 14 days under Article 13 where the token is not yet admitted to trading.[47] Issuers of ARTs, by contrast, require authorisation under Title III, must maintain a reserve of assets and must grant redemption rights (Articles 16, 36 and 39).[47] FYT is presented by its issuer as the former and expressly not the latter; a future ART application would be a new authorisation process, not an upgrade of the present notification.

19.2 EU CRCF — Regulation (EU) 2024/3012 — status at 26 September 2026

Instrument	Status	Relevance to ERW
Regulation (EU) 2024/3012 (CRCF framework)	In force since December 2024; voluntary EU certification framework for permanent removals, carbon farming and carbon storage in products[48]	Framework only; contains no ERW methodology
Implementing Regulation (EU) 2025/2358 (minimum requirements for certification schemes)	Adopted 2025; scheme-recognition process launched after the first delegated act entered into force[20]	Governs how schemes such as Puro.earth or Isometric could seek recognition
Delegated Regulation (EU) 2026/285 (permanent removals)	Adopted 3 February 2026; in force May 2026; methodologies for DACCS, BioCCS and biochar carbon removal[19,21]	Does not cover ERW
Delegated act on carbon farming (C(2026) 4666)	Adopted 10 July 2026; agriculture and agroforestry on mineral soils, peatland rewetting, afforestation; enters into force after scrutiny and publication[20]	Does not cover ERW; ERW is not classified as "carbon farming" under these methodologies
Enhanced rock weathering	Listed by the Commission among pathways being explored; technical workshop on ERW and ocean alkalinity enhancement held 25 September 2025; external methodology review commissioned (ICF/Cerulogy, July 2025); "work started on methodologies"[19,21,49]	No adopted or draft delegated methodology at the cut-off date

Table 19.1 — CRCF status. Sources: European Commission Climate Action pages and news (accessed 26 September 2026);[19,20] DG CLIMA state-of-play presentation, May 2026;[21] EUR-Lex.[48]

Implication. Any ERW credit generated in the EU before an ERW methodology is adopted, and before a scheme is recognised for it, is a voluntary-market unit under a private protocol, not a CRCF-certified unit. For a Balkan Basalt / Flour Yield project this means: (i) the operative benchmark today is Isometric or Puro.earth; (ii) designing to those protocols is the most plausible route to future CRCF eligibility, since the Commission's methodology work draws on the same science; (iii) no communication may describe such a project as "EU-certified" or "CRCF-eligible" at this time. Subject to regulatory development

19.3 Fertilising products — Regulation (EU) 2019/1009 and national rules

Basalt flour does not "automatically comply" with Regulation (EU) 2019/1009. Access to the EU-wide harmonised market as a CE-marked "EU fertilising product" requires the product to fall within a Product Function Category (for rock flour typically PFC 1(C)(I) inorganic macronutrient fertiliser, PFC 3 soil improver or PFC 4 growing medium, depending on claims), to be composed of permitted Component Material Category materials (CMC 1, virgin materials), to meet contaminant limits (including Cd, Cr(VI), Hg, Ni, Pb, As, and for some categories inorganic Cr and others), to meet performance/labelling requirements, and to undergo the applicable conformity-assessment module with technical documentation and EU declaration of conformity.[50] The harmonised route is optional: a producer may instead place the product under national fertiliser or soil-improver law (mutual recognition applies between Member States), and organic-input listings such as the Dutch Input List / FiBL confirmation address permissibility in organic farming under Regulation (EU) 2018/848 and Implementing Regulation (EU) 2021/1165, not conformity under 2019/1009.[4,51] Deltares' remark that a nickel value below 0.01% means the material "meets the standards" under 2019/1009 addresses one contaminant only and should not be repeated as a compliance statement.[2]

Verbs to keep apart

Notified (MiCA white paper) ≠ **approved/authorised** (ART) · **certified** (CRCF unit or registry credit) ≠ **validated** (project design) ≠ **verified** (reporting period) · **listed** (organic input list) ≠ **registered** (national product) ≠ **conformity-assessed / CE-marked** (EU fertilising product).

20 Risk and Claim-Control Register

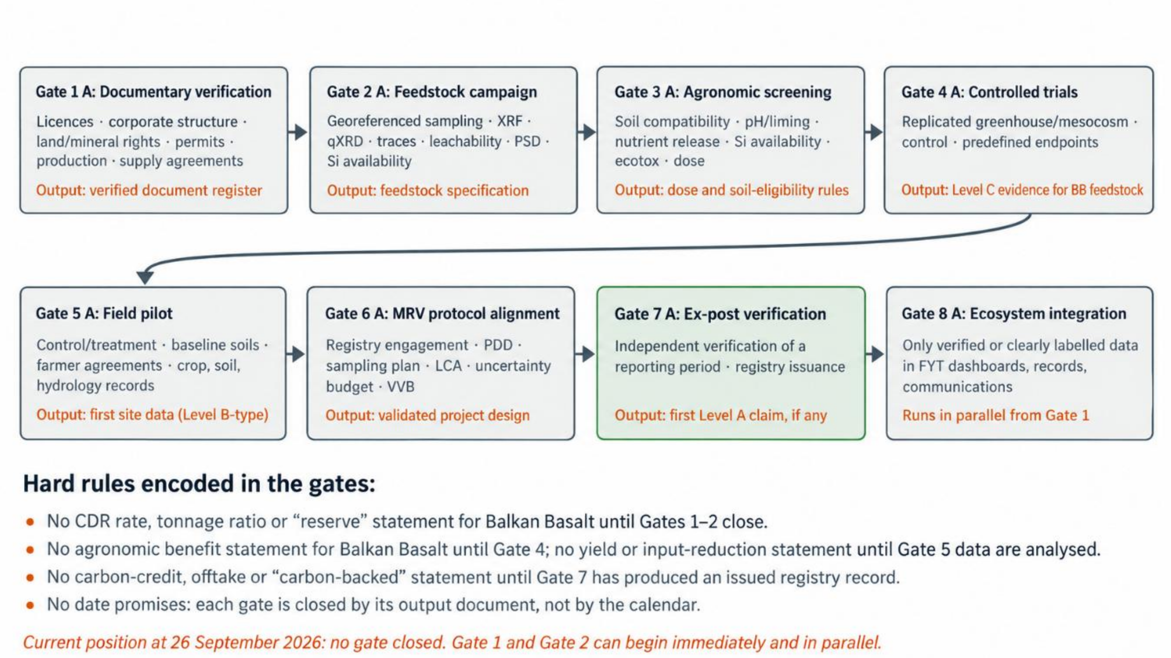
Controls are proposed; none is presented as guaranteed to be effective.

Risk	Evidence	Potential impact	Proposed control	Residual uncertainty
Scientific — uncertain weathering rates	Field CDR from ~0.03 to ~2.6 t ha^{-1} yr^{-1} across peer-reviewed trials[9,14]	Project yields far below plan; credits not issuable	Site-specific pilots with controls before any volume commitment; no rate claims before Gate 5	High until multi-year site data exist
MRV uncertainty and sampling cost	InPlanet moved to 1 sample/2 ha to gain precision[16]	Large uncertainty deductions; MRV cost exceeds credit value at small scale	Budget MRV as core cost; design sampling density with statistician; adopt protocol early	Moderate; protocols evolving
Non-carbonic acid weathering	Ammonium fertilisation and sulphide oxidation divert cations[12]	Weathering measured but removal disallowed	Record fertiliser inputs; protocol-compliant acid-budget correction	Site-dependent
Hydrological export and carbon fate	Degassing and ocean feedback reduce efficiency[28]	Deductions of downstream losses	Use protocol default loss factors; catchment monitoring where feasible	Moderate; science active
Lifecycle emissions	Grinding and transport can consume much of gross removal[34]	Net CDR small or negative for exported fine material	Full LCA per route; prefer application near quarry; low-carbon electricity	Depends on undocumented BB energy and logistics data
Grain-size / energy trade-off	Optimum size is a balance, not a minimum[27]	Wrong specification raises cost or slows removal	Test 0–4 mm by-product and ground fractions in Gate 4	Moderate
Environmental — dust and worker exposure	SiO_2-rich sample raises quartz relevance[3]	Occupational health liability	Respirable-fraction analysis; handling controls; spreading method	Unknown until tested
Trace-element accumulation and crop uptake	Cr 310, Co 93, Ni 30 mg kg^{-1} (order-of-magnitude);[3] Ni mobilisation from olivine rock reported[33]	Regulatory exceedance; food-chain concern	Quantitative and speciated analysis; loading limits per hectare; soil and crop monitoring	High until Gate 2 complete
Soil pH overshoot and nutrient imbalance	pH +0.5–1 on acid soils[11]	Micronutrient lock-up on neutral soils	Baseline pH screening; dose caps; exclude soils above target pH	Low with screening
Agronomic — variable crop response	Gain on sandy, none on silty-clay[11]	Farmer disappointment; adoption failure	Paired-strip trials; no yield promises	High across soil types
Farmer adoption and operational burden	10–50 t ha^{-1} logistics; InPlanet states rates need subsidy[16]	Low uptake without financing	Transition plans; cost-sharing; clear contracts on attribute ownership	Moderate
Regulatory — permit, classification, conformity	Expired FiBL listing; no 2019/1009 assessment supplied[4,50]	Product cannot be marketed as claimed	Determine route (harmonised vs national) per market; complete conformity or registration before sale claims	High until documents exist
CRCF methodology uncertainty	No ERW methodology adopted[19,21]	No EU-certified units; buyer eligibility limits	Design to Isometric/Puro; monitor Commission work	Timeline unknown
Market — credit price and offtake	Only company price statements exist[45]	Revenue below Memorandum assumptions	Do not publish price forecasts; seek offtake only after Gate 6	High
Double counting and attribute ownership	Registry protocols require unique claims[35,37]	Credits invalid; legal dispute among farmer, BB, Insela	Written allocation of environmental attributes in every farm and supply contract	Controllable by contract
Token — token-related misrepresentation	WP inconsistencies on deployment; "Basalt Reserve" label[1]	MiCA marketing-communication breach; reputational harm	Align all channels to Section 18 wording; legal review of "reserve" terminology; publish deployment status	Low if controlled; consequences severe if not
Outdated or conflicting project documents	Two chemistries; 220 Mt vs 110 Mt; 2024 Memorandum; expired listing	Loss of credibility with buyers and auditors	Single controlled document set with dates; retire superseded materials	Controllable
Reputational — greenwashing	Legacy claims (pesticide −20–60%, longevity, "no heavy metals")[6]	Regulatory scrutiny under EU consumer and green-claims rules; investor and buyer withdrawal	Claim ledger governance (Section 23); pre-publication review of every environmental statement	Depends on discipline

Visual 11 — Risk register. Sources as cited. Impact and residual uncertainty are qualitative judgements of this dossier.

21 Pilot and Validation Roadmap

Eight evidence gates, no promised dates. Each gate produces a document that the next gate depends on.



Visual 10 — Staged Balkan Basalt / Flour Yield pilot roadmap with evidence gates. Source: dossier design drawing on the Isometric protocol sequence[35] and the InPlanet procedural record.[16,40] No dates are shown because none can be evidenced.

21.1 Indicative gate outputs and independence

Gates 1 and 2 should be executed by parties without a commercial interest in the outcome (an independent geologist or competent person; an accredited laboratory with documented chain of custody), and their reports made available to prospective buyers and merchants in full. Gate 3 and Gate 4 may be run with a university or research institute under a published protocol with pre-registered endpoints. Gate 5 requires written farmer agreements that allocate environmental attributes and set out what happens to data if the pilot fails. Gate 6 requires a registry account, a project design document and an appointed validation/verification body *before* the first monitored application, because retrospective baselines are not accepted. Gate 7 is binary: a registry issuance exists or it does not.

22 Evidence-Calibrated Conclusions

22.1 What does current global evidence support about basalt and ERW?

Basalt flour, applied to acid or base-poor soils at agronomically significant rates, can raise pH and supply Ca, Mg and some P and K over seasons to years, and has been associated in peer-reviewed field studies with yield gains of roughly 12–30% in specific crop–soil–climate combinations and with no significant gain in others.[9,10,11] Enhanced rock weathering removes atmospheric CO_2 by a well-understood geochemical mechanism;[12,13] measured field removals range from about 2.6 t CO_2 ha^{-1} yr^{-1} (temperate Mollisol, 50 t ha^{-1} yr^{-1}) to statistically indistinguishable from zero (acidic tropical soil, same dose).[9,14] Independent verification of ERW removals is possible and has been achieved, at volumes in the hundreds to low thousands of tonnes per project, under protocols that require direct soil and porewater measurement, controls, lifecycle deductions and public data.[15,16,18] Theoretical capacity figures such as 20–25% of rock mass are stoichiometric ceilings, not achievable field rates on any documented time scale.

22.2 What does the supplied evidence support about Balkan Basalt specifically?

That Balkan Basalt reports operating a quarry at Spaç, Albania, and has commissioned a literature review that correctly identifies the conditions under which its rock might be useful and correctly states that field trials are required;2 that one submitted sample has a whole-rock chemistry which, if representative, would place the material outside the compositional definition of basalt and reduce its CO_2 capacity per tonne relative to the composition the company supplied to Deltares;2,3 that trace elements including chromium, cobalt, nickel, copper, zinc and lead are present at levels whose acceptability has not been determined by a quantitative method;3 and that a Dutch distributor's basalt dust was listed as an organic input until the end of 2024, without documented linkage to this quarry.4 Nothing in the supplied file establishes mineralogy, deposit variability, reserve classification, licence status, production capacity, regulatory conformity, agronomic performance or CDR rate.

22.3 What remains unverified or requires additional work?

Everything in Gates 1 to 7 of Section 21. The critical path is documentary verification and a representative feedstock campaign with quantitative mineralogy and quantitative trace-element analysis; without those, no controlled trial can be designed and no registry will accept a project design document. The reconciliation of the two chemical profiles is the single most important open question, because it determines whether the material is a basalt at all and what its Ca+Mg budget is. The Investment Memorandum's reserve, capacity, price and carbon-economics figures remain company-reported and should not be repeated without that label.

22.4 What role can FYT credibly play today?

According to its issuer, FYT is a MiCA Title II utility token with a fixed supply of one billion, notified to but not approved by the Bank of Lithuania, conferring no ownership, profit, dividend, redemption or delivery rights, spendable at variable prices for basalt flour and other products in participating shops if and when the marketplace and token are live, with discretionary and unguaranteed issuer cancellations and a Green Dividend that belongs to Insela UAB alone.[1] That is a coherent role: a payment, access and loyalty instrument for a regenerative-commerce network. It is credible only for as long as ecosystem communications keep the evidence labels of this dossier intact — company-reported where company-reported, theoretical where theoretical, planned where planned — and refrain from linking the token to basalt inventories, carbon outcomes or price. Balkan Basalt does not generate verified CDR today; FYT is not backed by carbon or basalt; and no finding in this dossier implies that project progress will create token value.

One-sentence summary

The global science makes the Flour Yield hypothesis worth testing; the supplied project evidence does not yet test it; and the token's credibility depends on saying exactly that.

23 Methodological Notes, Claim Ledger and References

23.1 Methodological notes

Uploaded documents were read in full. Peer-reviewed sources listed in the Deltares memo were used for the specific findings the memo attributes to them, with DOIs as printed there; where this dossier reports a detail (particle size, pH, design) taken from the Deltares synthesis rather than from the primary article, this is stated in the table caption. Web sources were retrieved between 24 and 26 September 2026; access dates are given. Registry quantities for InPlanet's second issuance and Mati's Isometric issuance were obtained from company or media publications and are labelled accordingly; readers should confirm them on the Isometric Registry. Prices were excluded from the evidence base. No figure was computed except the illustrative ratio in Section 13, whose arithmetic is shown. No image is used that could be mistaken for the Balkan Basalt quarry, laboratory or fields; all visuals are diagrams drawn from cited data or labelled conceptual frameworks.

23.2 Claim ledger (Appendix D)

Proposed claim	Source	Level	Context (geography · crop · type · dose)	Major limitation	Final permitted wording	Decision
33% of land moderately to highly degraded	7	Inst.	Global · assessment 2015	Definitions vary	"FAO/ITPS assessed in 2015 that about 33% of land is moderately to highly degraded"	Include
>90% of soils degraded by 2050	8, 22	Inst.	Global · communication 2019	Conditional; communication figure	"could … by 2050 if current trends continue (FAO, 2019)"	Include, qualified
Football pitch eroded every 5 s	8, 22	Inst.	Global	Illustration	As FAO communication illustration only	Include, labelled
Basalt raises yields	9, 10, 11, 30	B/C	USA maize–soy 50 t/ha/yr; UK oat; UK ryegrass; UK sorghum mesocosm	Soil-type dependent; nil on silty-clay	"yield gains of ~12–30% observed in specific peer-reviewed field studies; no significant gain in others"	Include, qualified

Proposed claim	Source	Level	Context (geography · crop · type · dose)	Major limitation	Final permitted wording	Decision
Basalt reduces pesticide use 20–60%	6	—	None	No supporting study	None	Reject
Basalt replaces fertiliser/lime	—	—	—	Contradicted by trial designs	"complement to, not replacement for"	Reject
Basalt-grown food improves longevity	6	—	None	Causal chain unestablished	Research-frontier box only; no health claim	Reject
ERW field CDR 10.5 ± 3.8 t/ha	9	B	Illinois · maize–soy · 200 t/ha cumulative · 4 yr	One site, one soil type	As stated with all context	Include
ERW field CDR 0.026 t/ha/yr, n.s.	14	B	Queensland · sugarcane · 250 t/ha · 5 yr	Acidic soil	As stated with all context	Include (negative result)
20–25% uptake; 4–5 t basalt per t CO_2	2	D	Theoretical · BB stated composition	Upper bound; no time scale; conflicting composition	"theoretical/estimated upper-bound concept derived from composition and literature"	Include, qualified
Investment Memorandum 1:4 ratio, €400/t, 50% pre-sale	5	E	Company projection Oct 2024	Not evidence	Legacy scenario box only	Qualify / isolate
235.53 credits issued to InPlanet	15, 16	A	Brazil · sugarcane · 10 t/ha · RP1 May 2023–Sept 2024 · 540 ha claimed	Tropical; small volume	"independently verified by Isometric; 235.53 credits; RP1"	Include
153.89 credits second issuance	17, 16	A (qty E)	Same project · RP2 Sept 2024–Oct 2025	Quantity from press release	"second verified issuance (May 2026); quantity company-reported pending registry check"	Include, labelled
Microsoft >28,500 t 2026–28	38	F/E	Brazil	Not issued	"offtake / forward delivery commitment"	Include, labelled
Actlabs chemistry 61.09% SiO_2 etc.	3	C (single sample)	One submitted sample	Undated; provenance unknown; base metals order-of-magnitude	"for the submitted sample only"	Include, qualified
Deltares chemistry 48.8% SiO_2	2	E	"35 m depth", company-supplied	No certificate	"composition supplied by Balkan Basalt to Deltares"	Include, qualified
"No heavy metals"	6	—	—	False for measured sample	None	Reject
FiBL confirmation = current certification	4	—	Titan Groep B.V. product	Expired 31 Dec 2024; different company	"historical input-list confirmation valid to 31 Dec 2024 for a Titan Groep B.V. product"	Qualify
Licence to 2050; 220 Mt; 47 ha; >1 Mt/yr; second line	5	E	Company document	No primary documents; conflicts with 110 Mt in ref. 2	"company-reported" / "company-reported geological inventory"	Include, labelled
FYT is a MiCA Title II utility token; notified not approved; 1 bn fixed supply; no rights; discretionary cancellation; Green Dividend to Insela	1	E (issuer)	White Paper V15	Deployment status inconsistent within source	Section 18 wording	Include
FYT is deployed / live / tradable	1	—	Conflicting statements	No current official confirmation	"the White Paper is internally inconsistent; not confirmed"	Qualify
1 Mt supply "backs" FYT	6	—	—	Contradicted by ref. 1	"operational supply allocation; not a reserve; does not back FYT"	Reject
ERW has a CRCF methodology	—	—	—	Contradicted by refs 19–21	"no adopted ERW methodology at 26 Sept 2026; work started"	Reject

23.3 Additional documents required for stronger project-specific claims (Appendix E)

1. Mining licence/concession and environmental permits for the Spaç operation, with holder, scope and expiry.
2. Corporate chart and chain of title from Balkan Basalt Holding B.V. to the Albanian operating company.
3. Geological resource/reserve report under a recognised standard with competent-person sign-off and effective date.
4. Audited production and financial statements supporting capacity and profitability statements.
5. A documented sampling campaign report with georeferenced sample locations and chain of custody.

6. Accredited laboratory certificates: XRF majors, quantitative XRD/Rietveld, quantitative trace elements (incl. Cr(VI) speciation), leach tests, PSD/BET, radioactivity, fibre and respirable-silica screening — per composite and per production batch.
7. Grinding and processing energy data and haulage/port emission factors for LCA.
8. The Purchase & Supply Agreement and custody framework referenced in White Paper V15, or a lawyer's summary of title and release terms.
9. Current product registration, national listing or conformity documentation for the flour in each target market; a current organic-input listing if that claim is to be made.
10. Official confirmation of FYT contract deployment, address and any admission to trading, and the Bank of Lithuania notification reference.
11. For any pilot: farmer agreements allocating environmental attributes; project design document; registry account and VVB appointment letter.

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Visual 2 (soil amendment vs ERW vs net CDR vs credit issuance) is realised as the six-quantity ladder and table in Section 11 and the four-box distinction in the pathway figure of Section 10, to avoid duplicating content within the page budget. Endnote numbers are unique to this dossier and unrelated to the numbering used in the Deltares memo.