

Public Summary of a Preliminary Assessment Report

CO₂ Removal Supplier	ZeroEx GmbH
Facility	ZeroEx
Facility ID	950375
Methodology	Enhanced Rock Weathering, Edition 2022, Version 2
Date of assessment	2024-05-07
Status	Final
Conclusion	Passed

This document contains the *Public Summary* of the Preliminary Assessment prepared by Puro.earth. The supplier has received separately the *Preliminary Assessment Report*, which contains more detailed remarks and recommendations.

Reminder: Sub-criteria either concern the facility's technical eligibility or its maturity and quality. There are three types of sub-criteria:

- **Required to be passed:** This applies to the core criteria related to facility eligibility. Suppliers must meet those criteria, as they may be otherwise impossible or costly to change at a later stage.
- **Required to be assessed:** These criteria are important for evaluation but do not necessarily determine pass or fail at this stage, as it is understood that the suppliers may be at different stages of development.
- **Not required:** These criteria are optional and do not impact the outcome at this stage. They may provide additional context or information about facility maturity but are not essential for passing the preliminary assessment.

For a facility to be considered eligible for listing, all the sub-criteria that condition eligibility must be met (i.e. passed or assessed). If one of those sub-criteria is not met, the facility in its current state of development is not eligible for listing.

1. Public Summary of the Preliminary Assessment

Disclaimer: The assessment has been made against the criteria in the current version of the methodology. Puro.earth relied on the CO₂ Removal Supplier for the correctness of the provided information during the time of the preliminary assessment and will make no representation as to the accuracy or completeness of this report. The CO₂ Removal Supplier must undergo a third-party audit before issuing CO₂ Removal Credits (CORCs). Passing the preliminary assessment does not guarantee a success in the third-party audit.

Overall evaluation: Preliminary Assessment is Passed.

ID	Criteria / Sub-criteria	Outcome	Comment	Evidence reviewed	Requirement for listed	Purpose of criteria
c1	Weathering material(s) is(are) eligible	Passed			<i>Passed if required sub-criteria are met</i>	
c1.1	<i>Types of weathering material are identified</i>	Passed	Two types of basalt with reasonable CDR potential are selected.	20240301_ZeroEx_Validation_Questionnaire	Required to be passed	Technical eligibility
c1.2	<i>Sources of weathering material (e.g. mine, quarry, recycling) are identified</i>	Passed	Two quarries currently used for sourcing. Further quarries identified.	20240301_ZeroEx_Validation_Questionnaire	Required to be passed	Technical eligibility
c1.3	<i>Composition of the weathering materials is characterized</i>	Passed	Suitable laboratory methods used, and analyses provided.	5_Laboratory_Analysis_Soil_Baseline: XRF, XRD, BET, PSA, ICP-MS data	Required to be passed	Technical eligibility
c1.4	<i>Economic leakage related to use of weathering material is minimal</i>	Assessed	Only a small amount of rock fines used in concrete or asphalt, mostly stockpiled at the quarry.	Additionality questionnaire	Required to be assessed	Technical eligibility
c1.5	<i>Sourcing of weathering material is legal and rightful (e.g. permits, authorisations)</i>	Assessed	Operating licenses for both quarries provided.	NEW_20240401_RPBL_Certification	Required to be assessed	Technical eligibility
c1.6	<i>Sourcing of weathering material is secured (e.g. letters of intent, contracts)</i>	Assessed	Weathering material sourced for pilot. Framework agreement in negotiation.	Additionality questionnaire	Required to be assessed	Maturity & Quality
c1.7	<i>Weathering material logistics (e.g. storage, transport) and processing (e.g. crushing, grinding) are planned or defined</i>	Assessed	Relevant weathering material logistics relate to transport and spreading, which has been done successfully in the pilot.	20240301_ZeroEx_Validation_Questionnaire	Required to be assessed	Maturity & Quality
c2	Application sites are identified, characterized, or secured	Passed			<i>Passed if required sub-criteria are met</i>	
c2.1	<i>Potential eligible application sites are identified in the facility area</i>	Passed	Agricultural land located in Rhineland-Palatinate in Germany.	20240301_ZeroEx_Validation_Questionnaire	Required to be passed	Technical eligibility
c2.2	<i>Characterisation of application sites (e.g. baseline soil sampling) is planned or conducted</i>	Assessed	Soil data from 7 farms were delivered, with 5 soil samples characterized per farm. These revealed differences in soil type, which may affect weathering monitoring and modelling.	Soil analyses (SS_23_BLM_AGR_0003, SS_23_BRA_AGR_0001, SS_23_EUL_AGR_0004, SS_23_HKM_AGR_0008, SS_23_MEY_LUFA_0002, SS_23_MUL_AGR_0005, SS_23_SRB_AGR_0006)	Required to be assessed	Technical eligibility
c2.3	<i>Contracts with landowners are drafted or completed</i>	Assessed	Contracts with several landowners were provided, including adequate terms (e.g. double counting, land use authorisation).	Signed landowner contracts (filename not disclosed for privacy) Translation 202308-1	Required to be assessed	Technical eligibility
c2.4	<i>Some application sites have been secured (e.g. signed contracts with landowner)</i>	Assessed	Ibid (2.3)	Ibid (2.3)	Not required	Maturity & Quality

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c2.5	<i>Weathering material has been applied to selected sites</i>	Assessed	The supplier started spreading basalt operationally in Rhineland-Palatine in 2023.	20240301_ZeroEx_Validation_Questionnaire	Not required	Maturity & Quality
c3	Weathering simulation model and its empirical validation	Passed			<i>Passed if required sub-criteria are met</i>	
c3.1	<i>A weathering simulation model is available, and its approach has been described in writing</i>	Passed	A model description was provided, including the elements required.	20240301_ZeroEx_Simulation_Approach	Required to be passed	Technical eligibility
c3.2	<i>The model takes in facility specific inputs (e.g. material properties, soil properties, weather data) as required</i>	Passed	Input parameters were listed in a separate document. Parameters include weathering material properties (composition, SSA, PSD, load), and soil properties (texture, composition). Local weather data (T and precipitation) are mentioned and used as inputs but missing in the excel input file.	20240301_ZeroEx_Simulation_Approach NEW_Selection_of_soil_samples_for_analysis NEW_20240205_Simulation_v2.xlsx	Required to be passed	Technical eligibility
c3.3	<i>The model outputs weathering and carbon removal curves with an explicit time dimension as required</i>	Passed	Model simulation results have been reported for a time span of 20 years. The graphs plot CDR accumulated in relation to the maximum potential of each rock powder. Other weathering signals were not shown, but likely available.	20240301_ZeroEx_Simulation_Approach, 20240301_ZeroEx_Initial_Simulation_Results NEW_20240205_Simulation_v2.xlsx	Required to be passed	Technical eligibility
c3.4	<i>The model outputs weathering signals that can be validated by empirical inputs from monitoring as required</i>	Passed	Yes. The output parameters mentioned are cation loss from the topsoil (which is compared to TiCAT measurements), base saturation and exchangeable fractions in the topsoil, pH, alkalinity, dissolved ion concentrations in the porewater.	NEW_20240402_Simulation_Overview NEW_20240205_Simulation_v2.xlsx	Required to be passed	Technical eligibility
c3.5	<i>The model includes weathering process losses (i.e. from strong acid weathering, plant uptake, riverine losses, and ocean losses)</i>	Passed	The model can account for strong acid weathering and plant uptake. Not for riverine and ocean losses. However, these can still be included afterwards as discounts to E _{stored} .	20240301_ZeroEx_Simulation_Approach, 20240301_ZeroEx_Initial_Simulation_Results	Required to be passed	Technical eligibility
c3.6	<i>Model description includes discussion and calculation of uncertainties related to site-specific spatial and temporal variability</i>	Assessed	Spatial heterogeneity is planned to be reduced by making composite samples and avoidance of outliers. Temporal uncertainty was discussed in the context of soil moisture and will be simulated by the model.	20240301_ZeroEx_Simulation_Approach, 20240301_ZeroEx_Initial_Simulation_Results NEW_20240205_Simulation_v2 (excel)	Required to be assessed	Technical eligibility
c3.7	<i>Model description includes discussion of model uncertainty (i.e. assumptions made, aspects not covered by model)</i>	Assessed	Yes. The uncertainties not covered will be added to the CORC calculation as discounts from the measured E _{stored} .	20240301_ZeroEx_Simulation_Approach	Required to be assessed	Technical eligibility
c3.8	<i>Initial weathering simulations have been submitted for the planned application events</i>	Assessed	Simulation results for the two types of rock and two types of soils are presented.	NEW_20240205_Simulation_v2	Not required	Maturity & Quality
c3.9	<i>A monitoring plan has been drafted for empirical validation of the weathering model</i>	Passed	Yes. It includes soil parameters (pH, major and minor elements, CEC, TIC, TOC) and soil water sampling (TA, pH, TIC, cations and anions).	20240301_ZeroEx_MRV_Approach NEW_ZeroEx_MRV_Approach	Required to be passed	Technical eligibility
c3.10	<i>The monitoring plan includes input parameters and output variables of the weathering model</i>	Passed	The plan has at least 4 input and output parameters that can be compared.	20240301_ZeroEx_MRV_Approach	Required to be passed	Technical eligibility
c3.11	<i>The monitoring plan specifies sampling temporal and spatial frequencies</i>	Passed	Extensive soil sampling is planned to be performed in years 1, 2, 5, 10, (20). In additional, some annual sampling on subset of areas is in planning. Sampling will follow the same procedure as for baseline sampling.	20240301_ZeroEx_MRV_Approach 20240301_ZeroEx_Validation_Questionnaire	Required to be passed	Technical eligibility

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c3.12	<i>The monitoring plan specifies how empirical data will be used to corroborate and calibrate the weathering model</i>	Assessed	Use of empirical data for model validation was not explained or developed at this stage.	20240301_ZeroEx_Simulation_Approach	Required to be assessed	Technical eligibility
c3.13	<i>The monitoring plan includes protocol for monitoring possible re-emissions (e.g. strong acid weathering)</i>	Assessed	There is soil water sampling planned in two locations 4 times per year, which can be used for such purpose.	20240301_ZeroEx_MRV_Approach	Required to be assessed	Technical eligibility
c3.14	<i>Measurement devices needed for monitoring have been identified or procured</i>	Assessed	Devices were identified. Most analyses will be outsourced.	20240301_ZeroEx_MRV_Approach	Not required	Maturity & Quality
c4	Facility has monitoring, reporting, and LCA capabilities or plans	Passed			<i>Passed if required sub-criteria are met</i>	
c4.1	<i>Information system used to keep data records is prepared</i>	Assessed	Information system to support scaling up efficiently is at an early development stage.	NEW_Information_System_Overview	Required to be assessed	Maturity & Quality
c4.2	<i>A monitoring plan has been drafted for monitoring of parameters needed for LCA calculations</i>	Assessed	Elements of data source for the LCA calculations included in the LCA report, primarily based on disclosure from quarry operator, farmers and contractors, own activity records and spending.	LCA Report (NEW_LCA_Word.pdf, Table 5)	Required to be assessed	Maturity & Quality
c4.3	<i>An LCA model specific to the facility's operation is prepared</i>	Assessed	An LCA model and an LCA report have been prepared, and are in finalization stage, enabling calculation of supply-chain emissions over course of activity.	LCA Report (NEW_LCA_Word.pdf), LCA Model (NEW_LCA_casecomparison.xlsx)	Required to be assessed	Maturity & Quality
c5	Environmental and social safeguards are ensured	Passed			<i>Passed if required sub-criteria are met</i>	
c5.1	<i>An environmental risk assessment (ERA) specific to the facility has been drafted or completed</i>	Passed	ERA has been completed, and it covers the required issues, such as heavy metals (in soil and rock), asbestos and radionuclides. ERA also touches upon other matters e.g. dust formation during application, soil quality and health indicators.	20240301_ZeroEx_Environmental_Risk_Assesement 20240301_ZeroEx_ERA_Excel.xlsx	Required to be passed	Technical eligibility
c5.2	<i>The ERA has been externally reviewed</i>	Assessed	A review seems to have been performed but may not yet meet the expectations of the standard. This can still be addressed.	NEW_20240304_ZeroEx_ERA_sig	Required to be assessed	Maturity & Quality
c5.3	<i>A monitoring plan has been drafted for monitoring potentially toxic elements (PTEs) in line with the ERA</i>	Assessed	The draft monitoring plan covers the critical issues in ERA. Soil samples analysed for CDR quantification will be also analysed for PTEs. The monitoring plan should be expanded to include monitoring of crops and to provide more details regarding the monitoring of soil fertility and soil health indicators.	NEW_20240325_Environmental_Monitoring_Plan	Required to be assessed	Maturity & Quality
c5.4	<i>Selected weathering materials and soils has been analysed for PTEs, enabling risk characterisation in line with the ERA</i>	Assessed	Weathering materials analysed for heavy metals and asbestos.	Multiple documents under 4_Laboratory_Analysis_Weathering_Material and 5_Laboratory_Analysis_Soil_Baseline	Required to be assessed	Maturity & Quality
c5.5	<i>Stakeholder consultations have been planned or conducted</i>	Assessed	Main stakeholders are farmers with whom there is initial contact and follow-up later.	20240301_ZeroEx_Validation_Questionnaire 202403~4	Required to be assessed	Maturity & Quality
c5.6	<i>Regulation applicable to facility has been identified</i>	Assessed	The supplier has identified Fertilizers Act and Fertilizer Ordinance as relevant.	20240301_LegalOpinion_Fertilizer	Required to be assessed	Maturity & Quality
c5.7	<i>Procedures to acquire relevant permits have been identified, started, or completed</i>	Assessed	No permitting requirements for spreading the rock.	20240301_LegalOpinion_Fertilizer 20240301_ZeroEx_Validation_Questionnaire	Required to be assessed	Maturity & Quality

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c5.8	<i>Occupational health and safety measures/policies have been planned or developed</i>	Assessed	Occupational health and safety hazards and mitigation measures have been identified in the ERA. Guidance is provided to farmers.	20240301_ZeroEx_Environmental_Risk_Assesement NEW_DE_Rock_Powder_Label	Not required	Maturity & Quality
c6	Additionality is demonstrated	Passed			<i>Passed if required sub-criteria are met</i>	
c6.1	<i>Carbon storage additionality to baseline</i>	Passed	Rock fines would mostly be stockpiled at a quarry without ERW.	Additionality questionnaire	Required to be passed	Technical eligibility
c6.2	<i>Financial additionality of facility</i>	Passed	Business plan supports additionality claim. No other revenues besides CORCs, though potential to apply for grants. Simple cost analysis provided.	Additionality questionnaire	Required to be passed	Technical eligibility
c6.3	<i>Regulatory additionality</i>	Passed	No known regulatory framework requiring land application of rock fines.	Additionality questionnaire	Required to be passed	Technical eligibility
c7	Facility has likely co-benefits and positive SDG impacts	Passed			<i>Passed if required sub-criteria are met</i>	
c7.1	<i>Facility-specific co-benefits have been identified</i>	Assessed	ERW co-benefits for agriculture have been identified, potential for further research.	NEW_20240205_Simulation_v2	Required to be assessed	Maturity & Quality
c7.2	<i>Facility-specific SDG targets or indicators have been identified</i>	Assessed	Not required under Puro Standard General Rules 3.1. It can be inferred that project can have positive impacts on food-related SDG targets and indicators, but these are not planned to be quantified yet.		Required to be assessed	Maturity & Quality
c8	Facility team has access to relevant knowledge and skills	Passed			<i>Passed if required sub-criteria are met</i>	
c8.1	<i>Relating to weathering material sourcing, handling, processing</i>	Assessed	Overall, the team is still relatively small and in early stages of their careers, but they have varied backgrounds in geology, geosciences, and environmental management.	CVs (names not disclosed for privacy reasons)	Required to be assessed	Maturity & Quality
c8.2	<i>Relating to geochemical reactions occurring during weathering of materials and its modelling</i>	Assessed	The team has both internal capacity in geochemistry and is supported by an external consultant.	CVs (names not disclosed for privacy reasons)	Required to be assessed	Maturity & Quality
c8.3	<i>Relating to environmental monitoring and carbon accounting</i>	Assessed	The team has both internal LCA capacity and is supported by an external consultant.	CVs (names not disclosed for privacy reasons)	Required to be assessed	Maturity & Quality