



# Health & ecosystem impact assessment for alkalinity enhancement deployments

Fall 2024

## Context

Frontier seeks to support promising carbon removal projects that can be done responsibly and maximize benefits to communities and ecosystems while minimizing potential harms. As a part of purchasing diligence, we assess the project's approach to legal and regulatory compliance, ecosystem safety and distribution of community benefits.

We have built mechanisms into Frontier's purchasing diligence and contracting to (1) minimize the potential known risks of projects; and (2) establish processes for adaptive management over time to ensure that projects stop if negative impacts are identified.

In some cases, existing regulations (OSHA, MSHA, EPA Controls, etc.) will be sufficient to manage project risks. For the specific safety risks where applicable regulatory regimes do not exist or do not fully retire the risks, Frontier uses the rubric below to inform whether to purchase from the project. This analysis also helps Frontier identify additional controls that should be added into the project contract to ensure safe, responsible deployment.

## This assessment rubric

This rubric was developed by environmental, safety and health sciences firm [Ramboll](#) to help reviewers for Frontier's offtake purchasing program assess whether a project removing CO<sub>2</sub> through alkalinity enhancement (electrochemical or mineral addition in oceans or rivers) (1) is set up for safe deployment and (2) has a best-in-class approach to monitor and mitigate any potential ecosystem and health and safety risks.

We do this by selecting for projects with low substantive risk and strong procedural controls across key risk categories:

- Low substantive risk - Risks are inherently lower because of the nature of the approach and the way the company has designed a deployment. For example, a project that uses a particularly well-characterized biomass feedstock.
- Strong procedural controls - A project has appropriate instrumentation and processes in place to monitor ecosystem interactions along with governance controls that trigger deployment shifts if any negative impacts are observed. For example, a project has a comprehensive plan to monitor local ecosystem impact parameters and a process to halt the intervention if variation is observed.

## Pre-Deployment assessment rubric

Assessment Category	Assessment Type	Assessment Description	Relevant BiCRS Pathway	Assessment Rubric			Guidelines for advanced monitoring & mitigation	
				High pass	Low pass	Needs improvement		
<b>1 - Overall Project Governance</b>								
a	Regulatory Compliance	Procedural	Project has controls in place to comply with local, state, and federal regulations	All projects	Proponent has a regulatory compliance expert and has a plan for compliance  Planning prioritizes hazard elimination where practical	Proponent has a regulatory compliance expert and has a plan for compliance	No regulatory compliance expert engaged and no plan for compliance	In the U.S., potentially applicable regulations include: <ul style="list-style-type: none"> <li>Local, State and federal permitting for injection wells and CO2 transportation</li> <li>Local, State and federal environmental regulations associated with air, water and waste.</li> <li>OSHA worker exposure, safety data sheet requirements</li> <li>Federal or state permitting for potential releases to water (storm runoff), plant wastewater discharge, air (fine particulates), or waste disposal (depending on wastes generated by energy production) and chemicals used for gas scrubbing (ethanolamine)</li> </ul>
b	Compliance with ongoing, transparent monitoring and reporting	Procedural	Project has established requirements for project reporting and auditing	All projects	<ul style="list-style-type: none"> <li>Proponent will receive regular, independent audits of environmental and safety outcomes for this project</li> <li>Proponent plans to transparently report audit findings and safety data to relevant project stakeholders, including communities</li> </ul>	Proponent will receive regular, independent audits of environmental and safety outcomes for this project	No plans for third party review or transparent reporting	
c	Compliance with project-specific plans and objectives	Procedural	Project clearly demonstrates climate benefits versus counterfactual	All projects	Proponent robustly demonstrates estimated carbon dioxide removal (CDR) benefit compared to counterfactual scenario, GHG baseline based on life cycle analysis (LCA) is assessed	CDR benefit, GHG baseline, and additionality demonstrated with low confidence level	Proponent does not accurately assess additionality or determine impact compared to baseline	<ol style="list-style-type: none"> <li>Ensure biomass was not destined for other CDR activities and publish vetting process</li> <li>The GHG baseline considers the baseline relative to each feedstock used, if projects utilize more than one feedstock type</li> </ol> <p>Specific project objectives will vary</p>
<b>2 - Local Ecological Impacts</b>								
a	Organic biowaste	Procedural	Project has a plan to source biowaste that has been sufficiently characterized	All projects	Proponent has committed to follow the requirements for organic waste sourcing in "Guidelines for advanced monitoring & mitigation." Plan to publish findings is encouraged for High Pass rating.	Safe injection, conversion, or use of organic waste is assumed without basis, no verification planned, proponent not prepared to take legal responsibility/accountability for wastes	<ol style="list-style-type: none"> <li>Plan to partner with industrial biomass processors who provide biomass with consistent composition, or sample frequently enough to determine composition</li> <li>Collect representative samples of selected biomass and analyze for pathogens, forever chemicals, hormones, pharmaceuticals, or other harmful components, to prevent future adverse environmental issues.</li> <li>Source biowaste responsibly so as to avoid nutrient-depletion at scale where it competes with land application of biowaste.</li> <li>Plan to only use the amount of organic biowaste proven to be sustainable that would not be otherwise applied (e.g. through biosolid land-application)</li> <li>Develop a plan to mitigate risk of subterranean methanogenesis, migration or leakage</li> <li>Develop robust monitoring, reporting &amp; verification (MRV) and sourcing policies within the project protocol</li> </ol>	

If a project passes the assessment and is selected for a purchase through Frontier, any the 'guidelines for advanced monitoring and mitigation' that are not already sufficiently addressed in existing regulation are incorporated into the project's measurement protocol and included in the purchase contract.

Frontier only accepts and makes payment for carbon removal deliveries if a project (1) demonstrates ongoing regulatory compliance, (2) provides third party verification that the activities comply with the protocol, and (3) transparently and publicly reports ecosystem impact data.