HUB BIOECONOMÍA

Econova Challenges #SosTECnibility®

Concept Brief of Open Innovation Challenges

Challenge #2:

¿ How to capture suspended solids and precipitates in the fluid of industrial water transportation pipelines under high pressure, so that they can be extracted in the traps located at the end of the pipelines, reducing solid drag and sediment accumulation?

Vice Presidency of Exploration, Development, and Production

Apoya: CONNECT OLIVIA

Organizan: ParqueSoft Meta y Amazorinoquia · GRUPO ecopetrol · ECONOVA

Challenge #2	How to capture suspended solids and precipitates in the fluid of industrial water transportation pipelines under high pressure, so that they can be extracted in the traps located at the end of the pipelines, reducing solid drag and sediment accumulation?	**Type**	Tactical
		Segment	Corporate / Upstream / Downstream/Midstream Industry/Low Emissions
		Status	Under construction / In validation / Approved for call / Launched
		Approval Date GNN	26/08/2025

BASIC DATA OF THE CHALLENGE			
Short description of the challenge	Proposals are requested for technologies with a sufficient level of maturity (TRL ≥ 4) that allow the implementation of a prototype capable of operating effectively at injection water velocities between 1 and 10 ft/s (feet per second) and at temperatures between 50 and 85°C (degrees Celsius) in a relevant operational environment of the Orinoquia Regional. The solution must perform the capture and extraction of solids, precipitates, and sediments in the pipelines without the need to stop the flow systems, ensuring an efficiency of >20% in the reduction of total solids in injection water lines. It is expected that the solids capture does not require the implementation of mechanical cleaning (pigging), as this type of solution cannot be applied to the pipelines where the technology would be tested. Robust solutions with high potential for industrial scaling are expected, strengthening alternatives for improving water quality at ECOPETROL under the principles of SosTECnibility and circular economy. The solutions must reduce the frequency and costs of filter maintenance, and the management of extracted waste resulting from the tests must be ensured. Finally, a business model and an analysis of technological scalability are expected.		
Filiales y/o Aliados estratégicos			
N/A			
Source of financing	Innovation Portfolio - Outsourced Operation with ParqueSoft Specific Science and Technology Agreement No. 3054627	**Total value**	A maximum of $240,533,333 million Colombian pesos (COP) as an incentive to be given to the innovator for the purposes of executing the pilot project in the field.

PROBLEM DESCRIPTION			
Affected Population	Orinoquia Regional Engineering Department, specifically personnel focused on upstream operational processes of the Ecopetrol Group, who use enhanced recovery systems via water injection.	**Baseline**	Baseline. Current total solids content in the injection water line.

Currently, the Orinoquía fields are experiencing a decline in the capacity of the installed infrastructure, leading to a reduction in operational efficiency. This is caused by solids present in the water injection process. These solids are derived from operational deviations in water treatment or natural deterioration of surface equipment (example, corrosion or erosion).

Solids in the water reduce pipeline diameters, decreasing flow and generating a second phase “solid component” (when it should only be water), leading to the following consequences

- Asset integrity: high susceptibility to under-deposit corrosion and microbiological corrosion. Assets are also affected by erosion and corrosion due to the presence of solids and sands in injection water quality.
- Plugging at the well formation face due to obstruction by solids in the reservoir.
- Flow restrictions, causing pressure increases and deviations from expected production.

The most frequently detected solids are:

- Sand
- Iron oxides
- Organic products

These consequences trigger a reduction in the useful life of assets, deviations in the expected production forecasts, and increase the risks of potential environmental impacts.

Background	The actions implemented so far have focused on mitigating some of the consequences. However, no major efforts have been directed toward the removal of solids and sediments present or accumulated along the water injection lines. Some of these actions have included: ● Implementation of pipelines made of polymeric materials and/or pipelines with internal coatings to prevent corrosion. Nevertheless, pipeline diameter restrictions and the carryover of solids toward the reservoir face remain in effect, meaning solids continue to exist within the ducts. Due to the use of polymeric and coated pipelines, the option of mechanical cleaning (pigging) is not applicable. In addition, because of their configuration, it is not possible to use conventional cleaning devices, given the presence in the line design of features such as unblocked bypasses, installation of non–full-bore valves, diameter changes, fittings with short radii, among others.

SCOPE			
General Objective	Generate value through the improvement of injection water quality, promoting the increase of asset capacity and lifespan.	**Indicator**	**Indicator**: Current total solids content in the line. **Target**: >20% efficiency in the reduction of total solids compared to the content prior to cleaning.
Specific Objectives	E1. Reduce sediment accumulation in water injection lines for recovery without halting system operation.	**Indicator and Target E1**	**Indicator**: Current total solids content in the line. **Target**: >20% efficiency in the reduction of total solids compared to the content prior to cleaning.
	E2. Reduce the frequency of filter maintenance	**Indicator and Target E2**	**Indicator**: Current intervention frequency. **Target**: Reduce intervention frequency.
	E3. Reduce maintenance costs derived from the frequency of filter maintenance interventions.	**Indicator and Target E3**	**Indicator**: Current intervention costs. **Target**: Reduce current intervention costs.
	E4. Project the technology towards scalability through a differentiated proposal.	**Indicator and Target E4**	**Indicator**: Background of implemented and/or scaled solutions. **Target**: Technological scalability analysis.
Target Audience	Regional Engineering Department of Orinoquía, specifically the staff focused on Upstream operational processes of the Ecopetrol Group, who use enhanced recovery systems through water injection.	**Location**	In the department of Meta, specifically in: Chichimene and/or Castilla fields (the suitable location will be selected based on the proposed solution).

Stakeholders	**Stakeholder 1**: Oil and gas companies. **Scope:** National. **Position:** Competitor. **Expectations:** Improvement of the recovery process through water injection. Contribution: Future client of the technology. **Stakeholder 2:** Chemical treatment companies. **Scope:** National. **Position:** User/beneficiary. **Expectations:** Reduction of treatment costs. **Contribution:** Strengthen the products offered by these companies. **Stakeholder 1:** Ecopetrol Group companies. **Scope:** National. **Position:** User/beneficiary. **Expectations:** Improvement of the recovery process through water injection. **Contribution:** Future client of the technology.
PDS – Product Design Specifications	The technology must be at TRL 4 or higher. For the selection of the technology, a minimal environmental impact must be considered in case of possible spills or accidental releases into the environment. The pilot must maximize the energy efficiency required for its operation. Likewise, it will be considered in the evaluation criteria that the energy used by the proposed technology be covered from renewable sources. The pilot designs must consider the scalability potential of the technology, ensuring that Capex/Opex costs are competitive compared to reference technologies in the market. The infrastructure available for the pilot must allow adequate experimentation, ensuring that the test system has a water line dedicated to the validation of the technology. It is important that the solution provider consider generating an action plan toward controlled conditions similar to real scenarios, such as tests in isolated systems, in case there is an operational restriction. Ecopetrol must guarantee the availability of an updated physicochemical analysis of the water before the execution of the pilot. The efficiency of the proposed treatment must be evaluated in comparison with traditional chemical processes, demonstrating possible savings in operating costs. The technologies proposed to address the challenge must be able to: ● Capture and extract solids, precipitates, and sediments without the need to shut down flow systems, allowing normal operational flow. ● Manage waste disposal from solids extraction with a Waste Disposal Plan, ensuring circularity. ● Provide technology validation at least at laboratory scale to demonstrate effectiveness under real/similar conditions before field testing. (Numeral 6.6. Accreditation of Experience in technological solution development of the Terms and Conditions and Annex 4). ● Propose trapping capacity, e.g., unit of solid weight captured per unit weight/volume of applied substance, or other equivalents. ● Ensure that solid capture does not require the implementation of mechanical cleaning (pigging), since this type of solution cannot be applied to the ducts where the pilot would be carried out. ● Be environmentally friendly (e.g., a biodegradable technology over time; not generating long-term impacts on the water used, communities, and/or the environment). ● Not generate impacts on asset infrastructure such as increased corrosion or others. ● Operate effectively at water temperatures between 50 and 85°C (Celsius degrees). ● Operate at water velocities between 1 to 10 ft/s (feet per second) without affecting effectiveness. ● Be able to adapt to different pipe diameters, from 4 to 16 inches. ● Withstand a pressure of 150 psi (pounds per square inch) without generating loss of solution effectiveness. ● Not pose a risk to human health. Must not be toxic. <u>Optional</u>: ● Although **<u>digital</u>** solutions are expected, the presentation of other types of technologies is not excluded. ● The technology may be extensible to capture and extract solids present in other fluids such as oils, hydrocarbons, among others, present in upstream pipelines. ● It is desirable that the technology be a gel-type and/or semi-solid and/or colloidal chemical substance.

Requirements	**HSE Requirements for Proponents** To apply for the call and participate in the selection process, the proponents and their allies must demonstrate that they have an Occupational Health and Safety Management System, in accordance with Colombian legislation. This must be evidenced by a certification issued by their Occupational Risk Administrator (ARL) within the last year. This requirement applies only to companies operating in Colombia. ParqueSoft reserves the right to verify the information submitted. ***Enabling requirements for the development of the implementation and experimentation phase of the pilots in the operations of Ecopetrol S.A.*** In addition to the above-described requirements, the following requirements shall only be submitted and fulfilled by the proponent selected to develop the experimentation phase of the pilots. **HSE Requirements for Selected Proponents (Annex 5)** For the execution of the pilot implementation and experimentation phase (Section 8.3 of the Terms and Conditions) in facilities where Ecopetrol S.A. has operational control, the following considerations must be followed: a). If the pilot operation does NOT involve the execution of critical tasks in HSE matters The proponent must read, follow, and comply with Annex 5: HSE Control 2 Requirements, as described by Ecopetrol S.A. For the signing of the Commencement Act of the contract/experiment agreement with ParqueSoft, the proponent must submit: ● HSE Plan according to the activities of the contract or agreement, guaranteeing: - Legal compliance in HSE.Risk identification and controls. - Hazard identification matrix. - Risk assessment and evaluation. - Promotion, prevention, and health control of the workers engaged in the contract/agreement. - Matrix for the identification of environmental aspects and impact assessment. - Comprehensive emergency management. - Other requirements described in Annex 5: HSE Control 2 Requirements. ● Certificate of performance of pre-employment and fitness occupational medical examinations for the workers in charge. ● Certification of compliance with phases I and II of Ecopetrol S.A.'s course on promoting safe, clean, and healthy work, or the document that modifies or repeals it; as well as competence certifications for specialties requiring them, issued by institutions accredited nationally or internationally, in accordance with Colombian legislation. ● Environmental permits or licenses required to execute the pilot. ● Proof of the Company or Workplace Risk Level classification in accordance with the contract/agreement to be executed (Certification from the ARL, in accordance with Article 2 of Decree 1607 of 2002), as described in Section 6.8 of the Terms and Conditions. b). If the pilot operation involves the execution of one or more of the following activities, considered critical tasks in HSE matters: - Work at heights - Confined spaces - Excavations - Mechanical lifting of people and/or loads - Work in bodies of water - Entry or intervention in low, medium, or high voltage electrical systems - Intrusive activities that interfere with an operational process and may generate a loss of containment of a substance The proponent, in addition to complying with the above, must submit the following certifications: ● RUC, with a minimum rating of 80%, issued by the Colombian Safety Council; or ISO 45001 Certification issued by a certifying entity; or ● Certification under other standards recognized by the oil industry, IGS/ISM Code, or Norsok S-006, or STOW, issued by a certifying entity. ● Read, follow, and comply with the recommendations described in Annex 6: HSE Control 1 Requirements, established by Ecopetrol S.A. c) If the pilot operation DOES NOT involve execution within the operational areas of Ecopetrol S.A, the proponent must carry out:

	Compliance with Law: The Proponent is solely responsible before Ecopetrol S.A and before international, national, and local authorities for compliance with the HSE requirements and obligations acquired on the occasion of this call, which shall be extended to its contractors and suppliers. **Cybersecurity Requirements and Risks:** Technological solutions derived from open innovation challenges must include comprehensive measures to ensure their safe and efficient operation, in accordance with the corporate guidelines of Ecopetrol S.A. This implies ensuring the protection of information, guaranteeing that the data generated are consistent, traceable, and useful for decision-making, and delivering a robust, clear, and well-defined technical architecture that allows its integration with the segmented network infrastructure provided by Ecopetrol S.A. Within the framework of this call, and solely for application purposes, the proponent must: Read, comply with, and complete Annex 6: Risks, Considerations, and Requirements in Cybersecurity, in order to classify the degree of vulnerability of the solution in terms of cybersecurity. If selected, and solely for the purposes of executing the pilot and experimentation phase: The proponent must incorporate in the development of its proposals the technical requirements described in Section 2. Proposed Architecture Concept of Annex 8: Digital Architecture Concept. Cybersecurity: Requirements for Open Innovation Challenges and, as applicable, the corresponding technical aspects of Section 4.1 of the same document.
Restrictions	To operate the solution correctly, the following restrictions must be taken into account: ● The solution must not be a toxic substance for the health of operators. ● It must be chemically inert and/or non-reactive, without generating interferences with the operational process. ● The implementation of the solution must not interrupt continuous operation. (Depending on the type of technology, for purposes of implementation and closure of the pilot, only two shutdowns may be considered.)
Expected Impact	The generation of a technological solution tested in a relevant environment (TRL ≥ 4) is expected, aimed at reducing the accumulation of solids and/or sediments in water injection lines for recovery. This prototype should contribute to decreasing well clogging, and to reducing the frequency and costs of filter maintenance. The technological proposal should strengthen Ecopetrol's current capabilities in operational efficiency and water quality improvement.
Value Levers	Operational Efficiency: Cost reduction through mitigation of filter maintenance and decrease of deferrals. Energy Efficiency: Cost reduction due to decreased energy consumption by avoiding clogging at the formation face. Improvement in Asset Integrity: Cost reduction through decreased material wear caused by corrosion and erosion, which extends the service life of pipelines and prevents their premature replacement.