CHALLENGE 2: Transformation of Carbon Emission Measurement through Analytical Models.

An open innovation challenge for the estimation of energy consumption in equipment based on modeling operational variables defined in technical data sheets.

Background

Hocol, a subsidiary of the Ecopetrol Group, boasts over six decades of experience in hydrocarbon production and exploration. Its operations are primarily concentrated in northern Colombia (Atlántico, Bolívar, Córdoba, La Guajira, Sucre), the Llanos region (north of Meta and south of Casanare), and the Upper Magdalena Valley (Huila and Tolima). Notably, Hocol stands as Colombia 's sole company actively engaged in offshore production.

Approximately 70% of Hocol's organic production originates from fields discovered by the company itself. Hocol's strategic strengths—technical expertise, agility, sustainable cost efficiency, and proactive environmental management—underscore its competitiveness and commitment to sustainability.

Throughout its history, Hocol consistently surpasses its self-imposed goals through diligent execution:

- Collaborating closely and harmoniously with communities, contractors, suppliers, authorities, and other stakeholders.
- Adhering to clear principles of responsibility and coherence that enable us to operate in an environment of respect and reliability in our activities.
- A dedicated team with a strong sense of professionalism, commitment, and leadership.

Hocol has made significant contributions to the development of Colombia, fostering trust, maintaining authentic and genuine relationships in the regions, and aligning with territory priorities.

Additionally, Hocol in its sustainability (sosTECnibilidad) policy declares that by being part of the territories where it is present, it seeks to be an example of harmony between the energy industry, communities and the environment, committing to developing its activities with a sustainability (sosTECnibilidad) approach. In this sense, its objective is to produce low-emission energy as a commitment to mitigate climate change and achieve neutrality in carbon emissions by 2025.

Context:

Hocol's Innovation strategy is part of the company's strategic framework that seeks to identify alternatives and solutions to achieve and exceed business objectives.

The Innovation strategy proposed for 2022 – 2024 involves the inclusion of different management models such as open innovation, to complement the internal capabilities of the organization and thus manage to address strategic challenges through a model of collaboration and co-creation with external actors.

On this occasion, the challenge we aim to address aligns with Hocol's carbon neutrality plan, which relies on continuous and rigorous monitoring of operational variables (fuel flows, power, delivered energy, consumed energy, etc.) in its production activities. These variables should enable the identification of trends, the prediction of scenarios, and the projection of greenhouse gas emission profiles.

Currently there is a limitation to achieving this objective given that a significant number of hydrocarbon producing fields operated by Hocol are mature and approaching their economic limit (at which point it is no longer profitable to produce them and keep them open). This has limited the investments required to implement the tasks and technical elements necessary to monitor the operational variables described above.

¿What objectives are associated with the open innovation challenge?

The document presented below pertains to the challenge: **¿How to transform Carbon Emission Measurement through artificial measurement using analytical models?** with the objectives to:

- Discover an unconventional, new development that enables the monitoring of operational variables required for tracking Hocol's greenhouse gas emissions. This development should be replicable and cost-effective.
- Influence business priorities by spearheading special projects with a comprehensive vision of continuous improvement that strengthens organizational performance and health. Through the innovation and open innovation ecosystem, we have achieved a 50% process acceleration with 20% efficiency gains.

1. PROBLEM

Currently, the mature crude production fields feature various equipment (generators, boilers, compressors, pumps, etc.) throughout the process that consume different types of energy (electricity, gas, or diesel) and, in turn, generate CO2 emissions.

As a whole, they have a general meter that provides manual measurements of the total monthly energy consumption across all equipment at the same location. These measurements report variations that are challenging to associate with a specific process or equipment, thus making it difficult to identify instances or areas of energy wastage. Furthermore, field personnel can estimate energy consumption analogously using the nameplate information of each piece of equipment, but these estimations are generally constant and exhibit significant discrepancies from the actual consumption.

Not knowing the individual energy consumption of the equipment increases the risk of energy inefficiency and, consequently, production costs and CO2 emissions. Therefore, there is a need for a solution that enables real-time identification of production process variations. This solution would become a tool for making data-driven decisions and projections to optimize processes, plan equipment maintenance, and more.

Currently, there are solutions that use sensors throughout the process to individually measure the consumption of each piece of equipment. However, these solutions are expensive and cannot be implemented in mature fields. Mature fields are those in the production decline phase, meaning they have less economic life, reduced production, and higher operational expenses. These factors lead to tight cash flow, preventing the development of costly investments without a guaranteed value proposition that positively impacts their cash flow.

Considering that Hocol's objective is to achieve carbon neutrality by 2025, it is necessary to have real-time information that enables them to understand the trends and behavior of their greenhouse gas emissions inventory.

We are seeking technological solutions that can make projections or predictions of energy consumption in mature fields, taking into account existing variables such as equipment operating hours, the consumed fuel gas, equipment efficiency, power, among others.

2. ¿WHO IS THIS CHALLENGE AIMED AT?

HOCOL is looking for companies or teams interested in providing a solution to the challenge: ¿**How to transform the measurement of carbon emissions through artificial measurement using analytical models?** (modeling of the energy balance of

each equipment) with creative, innovative and implementable alternatives.

The possible solvers for this challenge can be:
● Legally constituted MSMEs or large companies.
● Technology startups willing to model the solution based on what HOCOL needs and adjust their proposal that is legally constituted.
● Companies willing to sell the solution so that it can be maintained by HOCOL.
● Companies that have alliances with equipment supplier companies that are in the field.
●Temporary unions or alliances between different companies or entities.
● International companies (regardless of size) legally constituted.
● Universities or research groups according to the challenge.

This call does not have a geographical restriction and will receive proposals at a national/international level, as long as they respond to the specified requirements based on the variables indicated for the solution.

3. TYPE OF RELATIONSHIP BETWEEN HOCOL AND SOLVERS

Once a solution is selected, a test of the solution will be carried out by the solver, which will have the possibility of direct award depending on the results and the company's decision.

In all cases, we anticipate that the effectiveness results of the data analytics on energy consumption in the selected fields will be validated through a multilateral approach. This means that both the solver and Hocol will carry out the necessary tests to confirm its efficacy.

4. ¿WHAT IS EXPECTED FROM THE SOLUTION?

Software solutions in minimum TRL 5.

Some solution conditions expected to meet the challenge are:

●The solution must perform data analysis and energy consumption projections based on the information generated by the general meter and the existing variables in the field.
●The solution must model the data based on the general consumption data of the plant (meter compatible).
●Low-cost solutions that can be easily implemented, integrating with current HOCOL systems.
●The solution must upload information to the cloud MINIMUM 1 time per month.
●Achieve details of fuel gas consumed by equipment that is in the field.

● The solution must be cheaper than what exists on the market such as the installation of sensors or meters.
● Easily upgradeable and maintainable.
●The solution must create reports that can be consulted through different means (computer or mobile).

5. SELECTION CRITERIA

The solutions will be evaluated based on the following criteria:

Criteria	Description	Percent weight
Solution Maturity Level	The solution has been tested, proving to be successful in addressing the problem established by the challenge (Minimum TRL5)	20
Technical knowledge	The solver has experience, technical skills and capabilities relevant to meet the challenge. It has an interdisciplinary team with technical capabilities that can support the proposed solution	20
Innovation	The proposed solution addresses the challenge in a novel or unconventional manner, and it aligns with the conditions described in the challenge.	20
Description	The proposed solution is clear, includes technical information and budget to understand how the pilot test will be developed. Furthermore, it demonstrates in its proposal the intention to work collaboratively with the challenging team.	20
Time	The proposed solution	20

	has a pilot test development time that aligns with the complexity of the solution.	
	Total score	**100**

6. EXPECTED IMPACT OF THE SOLUTION

As measurable indicators for the solution, the following are established:

- Having technology that performs simulations or projections of energy consumption in the field for each unit or equipment component.

7. PARTICIPATION BENEFITS

The selected solver will receive the following benefits:

- Specialized guidance from Hocol during the solution's testing in an environment controlled by Hocol.
- Public recognition for the selected solver within the hydrocarbon sector's business circles.
- Possibility of direct award based on the test results and the company's decision.