NINOX

MOBILE LABORATORY · ENVIRONMENT · ENERGY SECTOR · 2021

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Mobile Environmental Laboratory for Ecopetrol

Field Science in the Service of Colombia's Ecosystems

CLIENT
Ecopetrol

LOCATION
Colombia

YEAR
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CLIENT

Ecopetrol

ECOPETROL · LABORATORY · ENVIRONMENTAL · MOBILE · MONITORING · SUSTAINABILITY · COLOMBIA · NINOX · LAB-VHC-MAX

> *Colombia harbors more than ten percent of the world's known biodiversity within its borders, and Ecopetrol — the country's foremost energy company — operates across territories where that natural wealth demands exceptional environmental stewardship. When the company sought a tool to monitor the impact of its operations directly in the field, bypassing the delays and analytical risks inherent in transporting samples to fixed laboratories, it turned to NINOX to design and build an unprecedented solution for the Colombian energy sector: a fully equipped, autonomous environmental analysis laboratory mounted on the NINOX LAB VHC MAX semitrailer platform. Delivered in April 2021, the unit represents a qualitative leap in how Colombian industry approaches environmental monitoring.*

01

The Environmental Imperative: Science Where Life Happens

Colombia concentrates more than ten percent of the world's known biodiversity on less than one percent of Earth's land surface. Rivers like the Magdalena and the Cauca flow through biologically sensitive corridors of enormous ecological value; the eastern plains and the Amazonian foothill forests are unique ecosystems where even minor chemical alterations to water or soil can trigger cascading consequences for fauna, flora, and the communities that depend on these resources. For a company like Ecopetrol — with wells, processing plants, and pipelines running through many of these zones — environmental monitoring is not merely a regulatory obligation. It is the backbone of a responsible relationship with the territory.

Until this unit came into service, the conventional environmental control process involved collecting water, soil, and air samples in the field, preserving them with specific reagents, and transporting them — sometimes across several hundred kilometers — to fixed laboratories located in urban centers. This cycle, beyond being costly and time-consuming, introduced critical analytical risks: volatile compounds evaporate, microorganisms alter biological samples, and the chain of custody grows increasingly complex with every hour that passes between collection and analysis. Results arrived late, and by then their representational value had sometimes declined to an unacceptable degree.

Ecopetrol framed the challenge clearly: eliminate the gap between the sampling point and the instrumental analysis. The answer could not be improving transport logistics; it had to be moving the laboratory itself to the sample location. This vision — simple in its statement, profoundly complex in its execution — was the starting point for the project that NINOX began developing alongside Ecopetrol's technical team in 2020.

02

A Laboratory at 100 km/h: The Engineering Challenge

Designing an environmental analysis laboratory on a semitrailer means resolving a set of engineering contradictions for which there are no trivial solutions. Analytical instruments — gas and liquid chromatographs, atomic absorption spectrometers, chemical oxygen demand analyzers, sample digestion systems, high-precision analytical balances — are sensitive machines that require stable environmental conditions: controlled temperature, freedom from vibration during operation, clean and regulated electrical supply, and chemically inert work surfaces. The vehicle's mission, however, is to move: to travel secondary roads, absorb the accelerations and braking of road traffic, park on uneven terrain, and operate in areas where the electrical grid simply does not exist.

The fabrication process began at NINOX's Cali facility in November 2020. The body was constructed using high-strength aluminum sandwich sections with a high-density thermal insulation core, guaranteeing an interior temperature of 18°C to 24°C regardless of the external conditions of the operational region. The climate control system was designed with full redundancy: primary and backup units ensuring operational continuity even in the event of a component failure. The electrical installation includes a diesel generating set with voltage and frequency regulation, together with external grid connection capability when the site permits, and full surge and voltage protection for the analytical instruments.

The internal layout was the product of deep technical dialogue between NINOX's engineers and Ecopetrol's scientists and analysts. The workflow — from sample receipt to analytical result — determined the zoning of the space: a sample intake and logging area at the entrance, a preparation zone with a fume hood for gases and vapors, an instrumental analysis area at the center, refrigerated storage for reagents and preserved samples, and an integrated workstation and reporting station at the rear. All cabinetry and benchtops were fabricated in AISI 304 stainless steel and chemically resistant laminate, with securing systems that immobilize instruments during transport and release them for operation once the unit is parked and leveled.

Aerial view of the laboratory body during fabrication at NINOX's Cali facility, November 2020. The aluminum sandwich structure with high-density thermal insulation core is visible in the assembly stage.

NINOX production floor with the semitrailer under equipment installation. In the foreground, the electrical generation system and NINOX precision welding equipment.

03

Science Arrives in the Field: Immediate Operational Impact

The unit was delivered to Ecopetrol in April 2021, completing a manufacturing cycle of approximately five months that encompassed conceptual engineering, detailed design, fabrication, installation of all analytical instruments, and commissioning tests. The final product is a unit fifteen meters in overall length — including the International Eagle SUE-192 prime mover — integrating the NINOX LAB VHC MAX platform in its highest analytical capacity configuration. The exterior body was finished with a high-resolution graphic wrap combining imagery of Colombian natural ecosystems with Ecopetrol's visual identity, making the unit a visible ambassador of the company's environmental commitment wherever it travels.

The operational impact of the unit is direct and quantifiable. Analyses that previously required 48 to 72 hours through the full cycle of sampling, preservation, transport, and analysis can now be completed within hours of sample collection, with results available at the operational site itself. Analytical quality improves substantially: samples are not altered by transport, volatile compounds are analyzed while still fresh, and the chain of custody is simplified to a minimum. Ecopetrol's teams can make environmental management decisions — adjusting operational parameters, activating response protocols, documenting baseline conditions — with real-time, high-reliability data.

The capacity to respond to environmental incidents is perhaps the most critical benefit. In a spill or contamination event, the speed and precision of analysis can determine the scope of mitigation measures, the extent of the affected area that must be remediated, and the efficacy of the treatments applied. Having a certified laboratory deployable within four hours of an event fundamentally changes crisis management: data arrives when it is still actionable, and decisions are made with scientific backing rather than estimates. This is not a marginal improvement in process efficiency; it is a transformation in how environmental responsibility is operationalized in the field.

The Ecopetrol Mobile Environmental Laboratory, designed and built by NINOX, at Ecopetrol's technology campus in Piedecuesta, Santander. The unit is ready for its first operational field deployment.

Full lateral view of the unit showing the complete truck-semitrailer assembly. The 15-meter overall length accommodates all functional laboratory zones without compromising mobility on secondary roads.

04

NINOX: A Benchmark for Innovation in the Energy Sector

The Ecopetrol Mobile Environmental Laboratory consolidated NINOX as one of Latin America's leading references in the design and fabrication of specialized units for the energy sector. The technical capability demonstrated — integrating the requirements of a high-complexity analytical laboratory with the physical and operational constraints of an autonomous heavy-duty vehicle — represents a level of specialization that few companies in the region can offer with the same depth of proprietary engineering. Every subsystem in the unit was conceived, dimensioned, and installed by the NINOX team, without dependence on external integrators.

The project also delivered significant institutional learning for NINOX: the standardization of the LAB VHC MAX platform as a proprietary product with modular adaptation capability across different analytical disciplines. From the design protocols established for this unit, the company can now respond to requirements for microbiology laboratories, water quality analysis, air quality monitoring, contaminated soil analysis, and industrial quality control, maintaining the same construction, climate control, and power supply principles that guaranteed this project's success.

Colombia, bearing the responsibility of custodying such a significant fraction of the world's biodiversity, needs its major energy companies to continuously raise the standard of their environmental management. The laboratory that NINOX built for Ecopetrol is precisely that: a demonstration that Colombian engineering is capable of producing instruments of scientific precision that transform how an ecosystem is protected. It is not merely a vehicle. It is a commitment to the future, on wheels.

Front-lateral view highlighting the International Eagle SUE-192 prime mover. The full mechanical, electrical, and communications integration between the truck and the laboratory was part of NINOX's complete design scope.

Rear detail of the laboratory unit showing the primary access door, redundant ventilation grilles for the climate control system, and the NINOX LAB VHC MAX identification plate.

“The Ecopetrol Mobile Environmental Laboratory is a demonstration of how specialized engineering can transform a costly, slow, and analytically compromised process into an efficient, reliable, and environmentally committed operation. NINOX designed and built a solution that not only meets the most demanding technical requirements of the sector, but redefines what it means to responsibly monitor an ecosystem in the twenty-first century. When the laboratory reaches the field, science works where life actually happens.”