NEXT-GENERATION GAS CHROMATOGRAPHY

Accurate Gas Analysis Across the CCUS Value Chain

Every stage of the carbon management process depends on knowing exactly what's in the gas stream. Micro GC Fusion® brings laboratory-grade gas chromatography into the field, allowing real-time gas analysis where and when the measurements are needed.

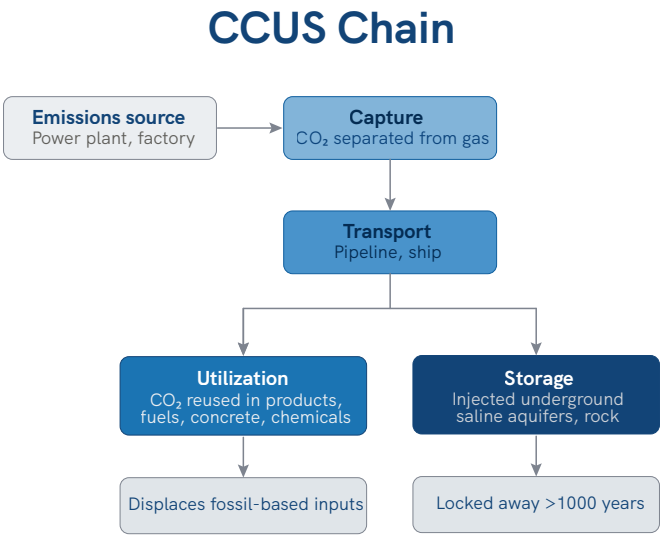
Introduction

The Carbon Capture, Utilization, and Storage (CCUS) industry is scaling fast. Global investment has grown more than 15-fold since 2020. There are over 70 large-scale capture facilities and more than 9000 km of CO_2 pipelines in operation currently, with another 30+ projects passing final investment decisions in the past two years. Every stage of these projects benefits from gas composition data—at the capture facility, along the transport network, and at the storage or utilization endpoint.

Gas chromatography has long been the reference method for multicomponent gas analysis in energy and industrial applications. As CCUS infrastructure expands into remote locations, constrained plant footprints, and temporary commissioning scenarios, there is a need for compact, field-deployable instruments that still deliver laboratory-grade precision.

GC Applications Across the CCUS Chain

Each stage presents distinct analytical challenges and distinct gas mixtures that must be characterized, verified, or monitored in real time.



CO_2 Capture: Plant Commissioning and Process Optimization

Post-combustion capture using amine scrubbing is the dominant technology at power plants, cement kilns, and steel mills. Operators need to characterize the inlet flue gas entering the absorber and verify that the CO_2 stream exiting the stripper meets purity requirements (typically above 99%). During commissioning and ramp-up, portable GC analysis lets process engineers tune absorber performance, diagnose breakthrough events, and validate design specifications without waiting for permanent analyzer infrastructure.

Ongoing process optimization also requires periodic checks at multiple sample points across the capture train—work that benefits from an instrument that can be carried to the measurement location rather than requiring fixed sample lines.

CO_2 Transport: Pipeline Integrity and Custody Transfer

CO_2 pipelines are the backbone of large-scale CCUS, yet there is no single international purity standard—ISO 27913 provides guidance, but actual specifications are set project by project. What every pipeline operator does agree on is that trace impurities like H_2S, SO_2, NOx, and O_2 must be kept extremely low, because in the presence of water they form sulfuric and nitric acid that corrodes carbon steel from the inside out.

GC analysis is needed at pipeline receipt and delivery points for custody transfer verification, at compressor stations along the route, and at blending nodes where CO_2 from different sources is combined. As new pipeline networks come online, every injection and offtake point needs reliable composition data.

CO_2 Utilization: Feed Purity for Conversion Processes

Carbon utilization is growing rapidly. Methanol synthesis combines captured CO_2 with green hydrogen to produce e-fuels. Enhanced oil recovery injects CO_2 to extract residual crude, currently consuming approximately 70–80 Mt per year globally. Mineralization processes react CO_2 with industrial minerals to create building materials.

In every case, the CO_2 feed stream composition must be verified before it enters the conversion process—contaminants that

are tolerable in a pipeline may poison catalysts, corrode reactors, or reduce product quality. GC analysis ensures the feed meets process-specific purity thresholds and helps operators quickly diagnose when upstream conditions change.

Geological Storage: MRV and Leak Surveillance

Once CO_2 is injected underground, regulators require Monitoring, Reporting, and Verification (MRV) to confirm it stays sequestered. This includes wellhead gas composition analysis at injection wells, soil gas surveys around the storage perimeter, and atmospheric monitoring at surface stations.

MRV protocols continue to evolve. Instruments deployed today at early-stage storage projects will help define the standards that the rest of the industry follows. Field portability is essential; monitoring points are spread across wide areas, often in remote terrain where permanent infrastructure is impractical.

Why Micro GC Fusion for CCUS

Traditional process GCs are designed for permanent installations with dedicated sample conditioning, climate-controlled enclosures, and ongoing maintenance contracts. CCUS projects often need something different—an instrument that can go where the measurement is needed, deliver results in minutes, and operate without specialized infrastructure.

Ready to Discuss Your CCUS Application?

Whether you're commissioning a capture plant, building a CO_2 pipeline, or establishing an MRV monitoring program, INFICON can help configure the right analytical solution.

More information → inficon.com

A 4-channel Micro GC Fusion (left) and a 2-channel Micro GC Fusion (right).

Advantages at a Glance

Field-Deployable, Lab-Grade Results
Compact and transportable, the Micro GC Fusion delivers high-precision multicomponent analysis directly at capture plants, pipeline nodes, and storage wellheads—no need to collect samples and ship them to a lab.

Fast Analysis Cycles
Complete gas composition results in 1–3 minutes. During capture plant commissioning or pipeline integrity checks, rapid turnaround means operators can make process adjustments in real time.

Multi-Channel, Multi-Component
Configurable analytical channels with independent column and detector options allow a single instrument to measure CO_2, N_2, O_2, H_2, CO, CH_4, H_2S, and light hydrocarbons up to C10+.

Low Operating Cost
Consumes significantly less carrier gas and power than a conventional GC. Minimal consumables and no licensing fees for the web-based software—critical for projects with dozens of monitoring points.

Web-Based Interface
Integrated touchscreen with license-free, browser-based software. Any technician with a laptop or tablet can configure methods, view live chromatograms, and export data with no proprietary workstation required.

MEMS Detection Technology
Advanced micro-electromechanical TCD detectors with fast temperature ramping deliver high sensitivity for trace-level impurities while maintaining industrial-grade ruggedness.

Proven in Energy Applications
Already deployed worldwide for natural gas, biogas, hydrogen, and LNG analysis. The same analytical platform that handles pipeline-quality natural gas composition is directly applicable to CO_2 stream characterization.

Built for Emerging Standards
With CCUS purity specifications still being defined per project, operators need flexible, high-accuracy instruments with configurable methods that can adapt as regulations evolve.

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