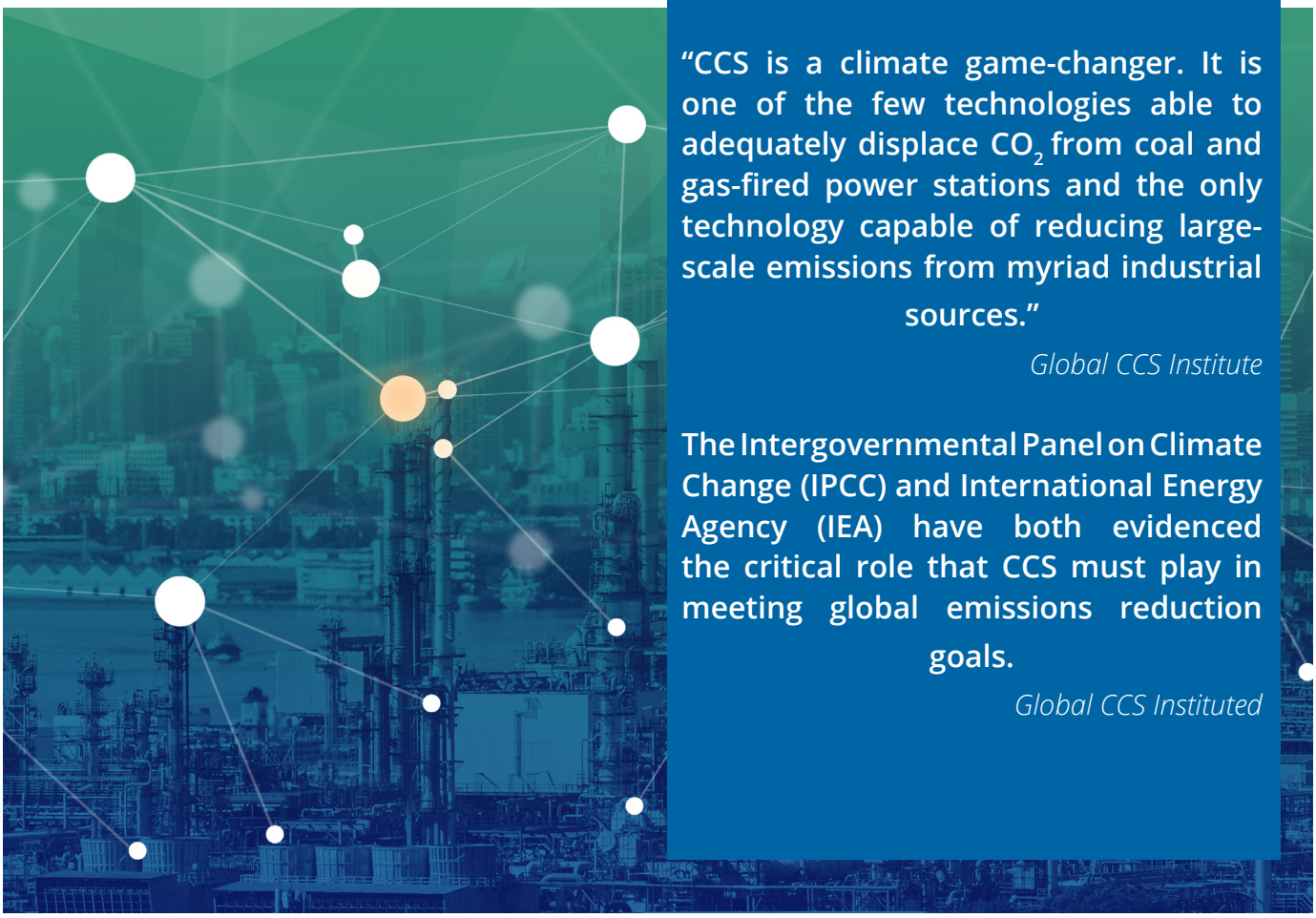
Carbon Dioxide Reservoir Evaluation

CO2re

Core Lab

CCS:at a glance



Why Carbon Capture?

"CCS is a climate game-changer. It is one of the few technologies able to adequately displace CO_2 from coal and gas-fired power stations and the only technology capable of reducing large-scale emissions from myriad industrial sources."

Global CCS Institute

The Intergovernmental Panel on Climate Change (IPCC) and International Energy Agency (IEA) have both evidenced the critical role that CCS must play in meeting global emissions reduction goals.

Global CCS Instituted

"CCS is an Essential Climate Change Technology"

OUR LEGACY

Core Laboratories has a long-standing reputation for developing innovative technologies to optimize reservoir characterization and performance. The Company's global network of laboratories spans over 50 countries and is staffed by world-class geologists, petrophysicists, geophysicists, engineers and chemists. These dedicated employees are the driving force behind the analytical programs and interpretations that help our clients achieve their CCS project goals.

ENTERPRISE SUPPORT

Working through multi-functional business units, Core Laboratories provides enterprise level support for CCS projects, including:

- Reservoir and fluid characterization services
- Perforating systems for well completions
- Diagnostic services for plume and containment monitoring
- Quality and quantity measurement and verification services for carbon accounting and reporting

Core Lab Services

Leveraging legacy technologies and capabilities to serve the growing number of clients sharpening their focus on reducing CO_2 emissions.

Core Laboratories utilizes proprietary technologies to provide insights into storage capacity and seal integrity, helping clients identify and optimize CO_2 storage sites.

Core Laboratories can also provide quality and quantity measurements with certification for the midstream and downstream portions of the CCS value chain, providing critical assurance services for transported and stored volumes.

Reservoir Characterization

Understand geological storage potential and geochemical reactions with reservoir characterization studies.

Seal Evaluation

Gather specific modeling inputs for seal capacity and lateral extent to meet regulatory requirements.

Reporting and Verification

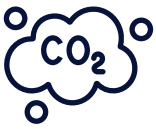
Quantify CO_2 in all phases to provide certification at production sites, pipelines and on vessels.

Quality and Quantity

Verify volumes to confirm capture efficiency and analyze purity to prepare mitigation strategies.

Formation Damage

Assess impacts of thermal and chemical interactions with CO_2 injection flow tests for modeling inputs.



Fluid Characterization

CO_2 characterization and brine composition analysis to meet fluid chemistry requirements.

Injection Monitoring

Monitor plumes with specific and dedicated proprietary chemical tracers.

Well Completions

Unique perforating systems to ensure fit-for-purpose well completions

Contact Core Lab for More Information
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Reservoir Characterization

Leveraging 86 years of global experience and expertise in reservoir description and characterization, Core Laboratories is your premier partner for CCS subsurface characterization.

We deliver best in class custom evaluation programs to ensure comprehensive subsurface risk assessment and timely regulatory compliance.

Further downstream, we are also a trusted partner for quantity and quality inspection services for carbon storage monitoring, verification, and reporting.

Geological Analysis

Dual Energy CT combined with integrated core description helps identify lithologies to calibrate geological interpretation on un-cored wells allowing for intelligent sampling to characterize the varying facies and potential injection sites.

Petrography

Combining thin section analysis with Core Laboratories proprietary RAPIDZoom™ scanning technology and XRD/XRF mineralogy analysis allows further calibration of facies models and identification of damaging mineralogy and clays to refine formation damage testing protocols.

Modeling

Data inputs refine reservoir simulation models for predictive evaluation of geochemical and pressure effects of storage and injection.

Seal Capacity

Caprock analysis to measure Capillary Entry Pressure utilizing CO_2 for threshold entry pressure tests. Unconventional characterization to quantify porosity and permeability for CO_2 storage and intrusion models.

Flow Analysis

Testing of Relative Permeability to CO_2 and water to calibrate Reservoir Model Forecasting for CO_2 migration and trapping. Identify Formation Damage issues that could cause permeability loss during injection.

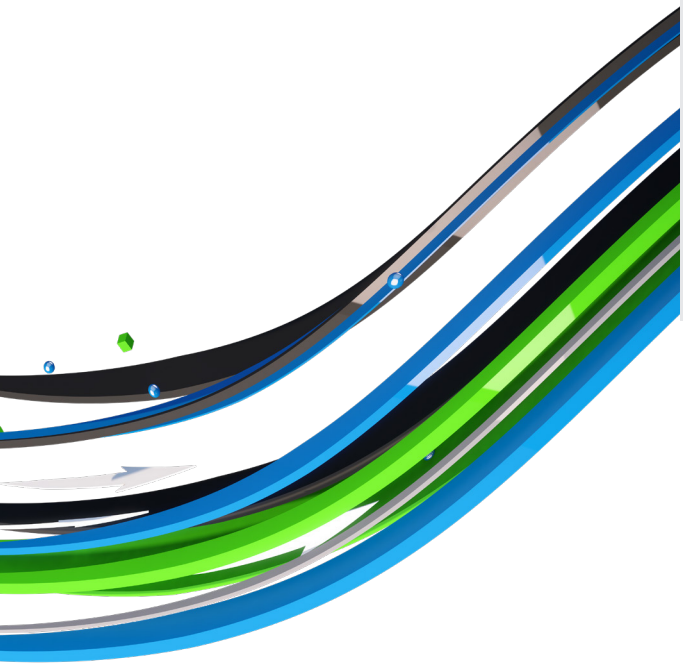
Fluid Analysis

Brine composition and CO_2 analysis to determine quality and potential components, including methane, NOx or SOx, that will affect fluid behavior. Minimum Miscibility Testing for depleted oil targets or Enhanced Oil Recovery.

Quality and Quantity

Quantify carbon dioxide in all phases to certify the amount stored and efficiency reporting at the production site, in pipelines and on vessels. Go beyond on-line analyzers to assess CO_2 quality by building a monitoring strategy for proactive

86 Years of Reservoir Evaluation. Any Reservoir.



CCUS Consortium

Core Laboratories is offering an industry led consortium to address and understand the risks and challenges associated with geological storage of CO_2. Each year the topics are voted on by member companies. Historical year's programs will be accessible by new members.

2023 Program Details

Geochemical Alterations

Determine geological, petrophysical and geomechanical changes from mineral dissolution and precipitation

Relative Permeability

Assessment with physical lab measurements and digital evaluations on mobility of CO_2-brine-oil including trapping, dispersion and fingering of CO_2

Solubility

Evaluate the extent of CO_2 solubility in various brines and hydrocarbons

Partnering with Dr. Birol Dindoruk - Professor University of Houston

Core Laboratories is pleased to partner with Dr. Birol Dindoruk, University of Houston, for this consortium. Dr. Dindoruk is a member of the National Academy of Engineering for his contributions in the areas of gas injection and CO_2 storage.

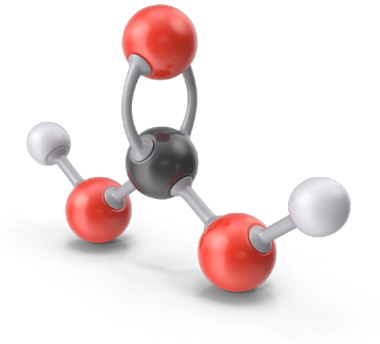
Case Studies

Our integrated team of experts are available to provide input on various aspects of your CO_2 injection and sequestration program. Specifically designed case studies offer solutions to address challenges associated with these storage operations, ensuring proper data is gathered to meet regulatory requirements for safe and effective CO_2 storage.

Dissolution and Precipitation

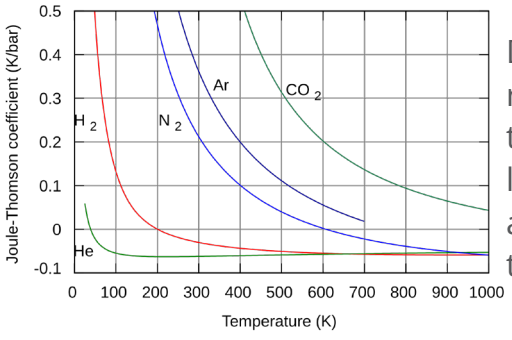
Effects on Seals and Wellbore Cements

An experiment was designed to visualize and quantify the dissolution effects from acidic, CO_2 enriched brines over a prolonged period of time to understand how the subtle geochemical changes impact strength. Dissolution effects were measured on pre and post testing and precipitation was modeled to predict potential permeability restricting deposits.

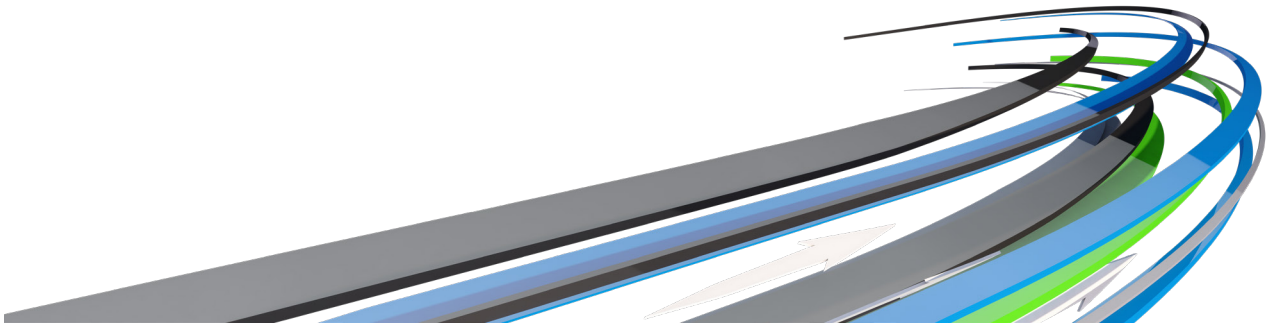


Thermal Shock and Cooling

Impact on Formation Strength from Joule-Thomson Cooling Effect



Depending on the transportation and pressure reduction process, CO_2 can reach sub-zero temperatures during injection. Geomechanical lab studies provide insight into how the mineral and rock strength are impacted due to the thermal effects of this extreme cooling.



Custom Equipment

Automated Rel-K for CO_2 Flow Experiments

Core Laboratories Instruments' Automated Relative Permeability System was designed to handle specific flow studies needed to understand the mechanisms and modeling inputs for CO_2 injection. This unit is fully customizable, with configurations available for confining pressures up to 15,000 psig, pore pressure up to 12,000 psig and temperatures up to 392°F (200°C). Automated data acquisition logs pressures, temperatures, flow rates and volumetric data.

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