Gaffney Cline

Carbon Management Expertise

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What makes us different in carbon management?

GaffneyCline expertise and experience provides impartial and confidential advice in subsurface resource assessment and development. It is our integrated nature and ability to identify and focus on what really matters that differentiates GaffneyCline from our competitors. GaffneyCline's experienced staff provides all the capabilities found in an integrated oil company, and our methods are specifically designed to meet our client's technical, strategic, and commercial objectives.

Carbon management

The new Carbon Management practice at GaffneyCline builds on our oil and gas expertise by performing technical, commercial and strategic assessment of carbon & climate risks and opportunities. This provides trusted, 3rd party due diligence to our clients in their evaluations, reporting requirements, permit applications, and financial transactions.

The Carbon Management practice provides four offers to our clients that can be combined into a systematic approach to understand and solve energy transition issues related to oil and gas resources, assets and investments:

1. **Quantification of carbon intensity** (the amount of CO2 equivalent emissions per unit of product) for benchmarking against an existing database of 9,000 fields across 90 countries as not all fields are created, developed, or operated equally.
2. **Evaluation of carbon and climate policies and regulations** across the value chain (from reservoir to point of sale) and how these may influence business competitiveness over time.
3. **Assessment of carbon solutions** that are available to avoid, reduce, replace, offset or sequester CO2 equivalent emissions in a cost-effective, time-based manner to ensure continued compliance and competitiveness.
4. **Verification of emissions reductions** to provide an independent view for stakeholders and enable realization of associated benefits.

These insights, coupled with GaffneyCline's expert analysis, enable our clients such as E&P companies, midstream, downstream, utilities, equity investors, sovereign asset owners and regulators to make informed decisions on project acquisitions, developments and investments.

Technical, commercial and strategic assessment of carbon and climate risks and opportunity

Carbon capture, use and storage

Whilst there is no silver bullet to Carbon Management, Carbon capture, use and storage (CCUS) is a critical tool for delivering a low carbon energy transition at lowest cost.

Without CCUS, the cost of meeting mid-century deep decarbonization targets would double. CCUS technologies are proven, reliable, and ready for scale-up and further cost reduction to capture CO2 streams from stationary process and combustion emission sources and storing the CO2 in geological formations, or transforming and securing it into manufactured products. For existing businesses that rely on the production and use of fossil fuels, CCUS manages the risk of future domestic and international carbon and climate policies, as it caps CO2 emissions liabilities at effectively US$100/tonne. However, CCUS is not just a technology that abates the production and use of fossil fuels, given it also enables the direct removal of CO2 from the air via direct air capture (DAC) and opens the way to negative emissions.
Opportunities exist today to commercially match CO2 supply cost with demand revenues, such as at scale through enhanced oil recovery (EOR), or at lower scales in food & beverage, chemicals and materials manufacturing processes. Further deployment of CCUS, especially in fossil fuel combustion sources, is dependent on transitional incentives and a market willingness to pay for low carbon products and/or a cost on CO2 emissions that are emerging across the world.

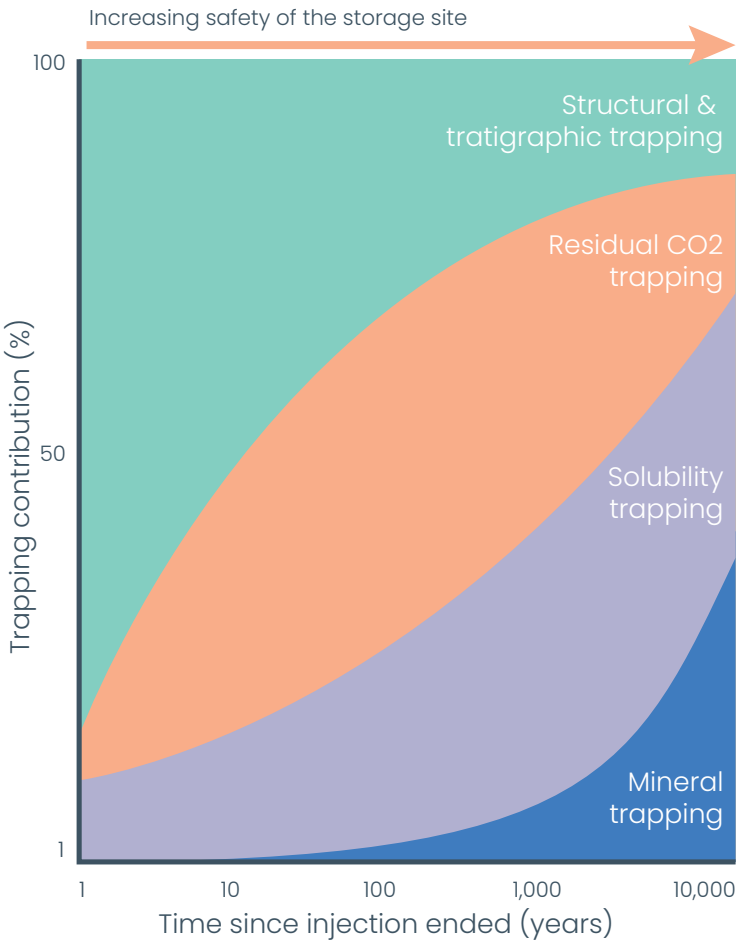
Geological CO2 storage

Successful storage of CO2 requires a secure geological container. A site selection process starts with asking some fundamental questions about the geology and target rock formations. As with oil and gas recovery, our geoscientists and petroleum engineers conduct a staged site characterization process of the target region and then focus on particular formations, enabling the client to gain confidence through performance based uncertainty reduction of the essential elements of CO2 storage – capacity, containment, and injectivity.

Capacity
The storage site must have sufficient connected pore volume to store all the CO2.

Containment
An overlying complex of formations is required that provides a sealing package to ensure containment of all fluids, and CO2 trapping mechanisms will ensure that this CO2 remains permanently stored.

Injectivity
The formation characteristics must be such that sufficient injection of CO2 from the wellbore and displacement of native fluids effectively occurs into connected pore volumes over the lifetime of the project which does not compromise the capacity or containment.



Our capabilities

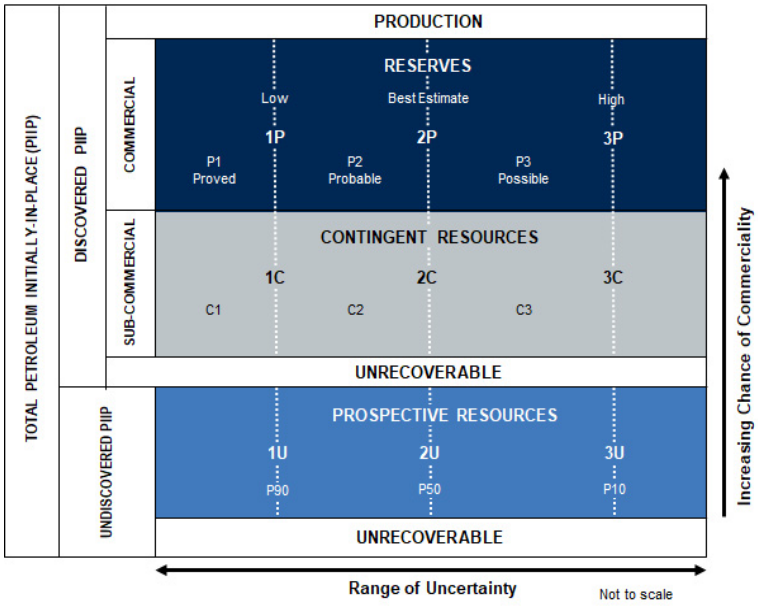
GaffneyCline's experts have been involved in industry leading CCUS projects, technology and capability development initiatives over the last 2 decades, including:

- Projects in Algeria, Australia, Canada, Denmark, Germany, Indonesia, Netherlands, United Arab Emirates, United Kingdom, and the United States.
- Chair of the SPE European Forum on CO2 Storage 2011.
- Chair of the CO2 Capture Project (CCP) Phase 3 2012-15, which received a Global Achievement Award from the Carbon Sequestration Leadership Forum (CSLF).
- Chair of the North American CCS Association 2012-15.
- Program Chair of the SPE CCUS Technical Section 2014-17.
- Deputy Chair of the United States National Petroleum Council's CCUS study Coordinating Subcommittee 2018-19.

Right tool for the job

Dependent on the needs of our clients and available data, we use a range of oil and gas industry proven practices, supplemented with bespoke tools available for CO2 storage evaluations. This includes use of analytical models such as material balance, and numerical models such as black oil or fully compositional simulation. We have also provided input, and continue to been involved with the development of various industry standards, tools, guidelines and regulations such as:

- The CO2 Capture Projects (CCP) 'A Technical Basis for CO2 Storage', 2009.
- The United States Environmental Protection Agencies (EPA) 'Underground Injection Control program Class VI rule', 2010.
- European Commission 'CCS Directive', 2011.
- Society of Petroleum Engineers (SPE) 'Storage Resource Management System (SRMS)', 2016.
- U.S. National Risk Assessment Partnership (NRAP) Toolset, 2016.
- The International Standards Organization (ISO) 'ISO-27914', 2017.



Our experience

GaffneyCline has been involved in over 65 CO2 CCUS screening and feasibility studies for clients over the last 20 years..

Enhanced Oil Recovery in Canada

A comprehensive study to evaluate the potential of CO2 injection throughout Alberta. Scope included finding suitable fields, incorporating a workflow with static, dynamic, and economic parameters as well as generating a list of pools with potential for EOR through CO2 injection. Generated a CO2 demand forecast for Alberta given a range of oil price, CO2 price, and reservoir suitability.

CO2 Contaminated Gas Field Development in Pakistan

A Lender and Buyer wanted technical and commercial due diligence on high content CO2 and N2 assets in Pakistan. Most assets had, so evaluation included a large gas processing plant to remove these contaminants.

CO2 Storage Evaluation in the Middle East

A major Middle Eastern National Oil Company needed to understand the potential of CO2 storage during EOR. An extensive subsurface study with two reservoirs considered; a mature water flooded reservoir for EOR through a multiple contact miscible flood process, and an undeveloped reservoir where the objective would be CO2 storage. Scope included laboratory experiments as well as detailed dynamic simulations of various field level pilot and full development project configurations.

Evaluation of CO2 EOR in a North Sea Oil Field

Scope included a review of the operator's compositional simulation model to assess the reliability of the forecasts as well as a review of basic input data, including fine scale numerical simulation of slimtube experiments. Limitations of the model to reproduce chemical processes were quantified. Multiple sensitivity runs created an overall envelope of forecasts to capture the range of uncertainties in the full-field model.

Review of CO2 EOR in Middle East Reservoirs

Scope included a comprehensive literature survey of EOR projects worldwide and compared key reservoir characteristics that determine success. Industry best practice techniques were used to screen the reservoirs and benchmark them. An equation of state was developed, matched against laboratory experiment results for the highest-ranking reservoir fluid. The reservoir development plan was reviewed against KPIs.

Gaffney Cline

For more information about GaffneyCline's integrated services, please contact your local GaffneyCline office.

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