

Gaffney
Cline

Carbon Capture, Utilization and
Storage Expertise





Energy Transition Introduction

The world is facing unprecedented uncertainties in energy markets due to the impact of policies and technologies related to the low carbon energy transition.

The reduction of greenhouse gas (GHG) emissions has increasingly become a priority for the business community, including companies active in the oil and gas supply chain. According to the IEA, 15% of global energy sector GHG emissions are associated with oil and gas supply, about 5,200 million tonnes (Mt)/year. In Upstream Exploration and Production (E&P) activities, the majority of emissions are associated with the venting, flaring and fugitive emissions of natural gas, and the energy associated with the production of oil and processing of natural gas, which releases significant amounts of carbon dioxide (CO₂) and methane (CH₄) emissions into the atmosphere. While CO₂ and CH₄ have significantly different GHG impacts, their combined effects can be aggregated as a single unit measured in tonnes of CO₂ equivalent (tCO₂e) and referred to as 'carbon' emissions.

Climate and carbon-related risks to oil and gas include litigation, threats to infrastructure, and most notably reduced demand. Significant cost reductions in renewable energy over the last decade, quicker and greater than anyone expected, means the oil and gas industry must be responsive in order to align with climate policies and societal choices. Investors consider these above-ground risks seriously, compounding recent oil price fluctuations on the opportunity costs associated with the long-term future value of their investment.

As institutional investors and private investment funds are requesting oil, gas and energy companies to evaluate and disclose carbon emissions impacts and climate-related risks to their portfolios, it is becoming an imperative for oil and gas companies to do more bottoms-up portfolio analysis.

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.

Carbon Capture, Utilization and Storage

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

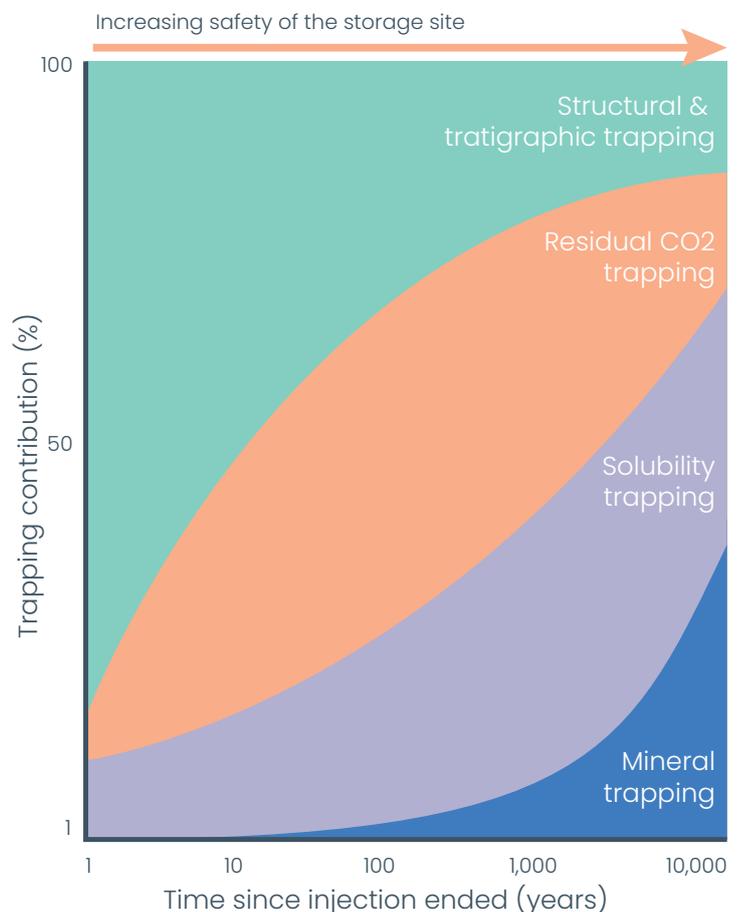
The storage site must have sufficient connected pore volume to store all the CO₂.

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

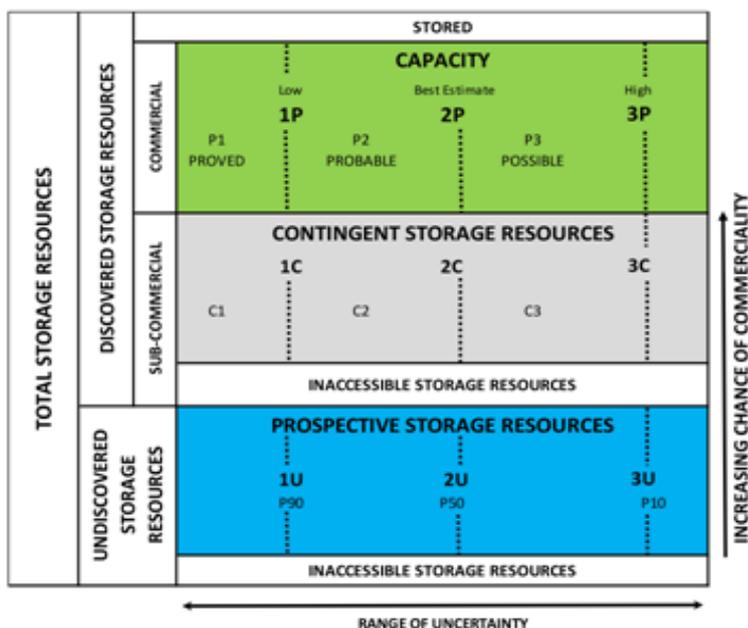
GaffneyCline’s experts have been involved in industry leading CCUS projects, technology and capability development initiatives over the last two decades, including:

- 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 be 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.



GaffneyCline's Energy Transition Services

We use a range of proven energy sector practices supplemented with bespoke tools for energy transition and carbon management evaluations in addition to harnessing the wide range of research and development data available.

The Energy Transition Practice provides five major capability pillars to our clients that can be combined or provided on a bespoke basis as required.



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

Pillar 1. Carbon Intensity Evaluations

Carbon intensity (CI) is one of the key capacity pillars of GaffneyCline's Carbon Management Practice. GaffneyCline is at the forefront of CI reporting in terms of assisting our clients to understand business risk and to safeguard or add value.

CI is a measure of the CO₂ equivalent emission per unit of energy (gCO₂eq/MJ) produced and is related to several factors including level of methane emissions and recovery methods used.

We offer three approaches in our CI evaluations, but all are underpinned by peer reviewed, regulatory-used tools.

1. **For detailed assessments of Upstream GHG Emissions:** we use the Oil Production Greenhouse Gas Emissions Estimator (OPGEE) tool. This tool was created by Stanford University having been commissioned and used since 2011 by the Californian Air Resources Board for crude oil life cycle CI assessment. The tool is a lifecycle assessment of emissions and accounts for contributions for all upstream phases, i.e. exploration, drilling, production, surface processing and transport to refinery. OPGEE takes a set of 50 inputs for each oilfield with 'smart defaults' gleaned from publically available data sets.
2. **For Downstream GHG Emissions:** we use PRELIM (Petroleum Refinery Life Cycle Inventory Model). The PRELIM tool was created by the University of Calgary. It is a mass and energy-based, process unit-level tool for estimating the energy use and the CI associated with processing a variety of crude oils within a range of configurations in a refinery. It combines a lifecycle approach with linear programming modelling methods.
3. **For Strategic and Advisory Support Decisions:** we offer an overview-level classification system approach based upon recovery, transport and refining methods.

GaffneyCline Database: For all approaches, we use our GaffneyCline in-house database of the CI of circa 9,000 global fields from over 90 countries for effective benchmarking and to assign a CI rating based on our proprietary classification system. This provides for benchmarking of assets, regions, portfolios and corporate performance.

Pillar 2. Evaluation of Policies and Regulations

Carbon pricing can detrimentally affect project economics and could have a negative impact on hydrocarbon Reserves in an upstream context and the strategies developed to include carbon offsets and credits can also significantly impact commerciality.

GaffneyCline builds on its existing strategic advisory expertise to help companies understand the impact of these new regulations and reduce the threat to business competitiveness.

Services include: review of carbon credit types (by technology, scale, distribution and volumes); carbon credit procurement strategy options and identification of premium differentiators; advice on monitoring, reporting and verification standards and processes; and assessment of negative emission technologies (NETs), nature-based carbon solutions (NBS) and deforestation and degradation (REDD+).

Pillar 3. Assessment of Carbon Solutions

GaffneyCline can offer an expert view on the full range of Carbon mitigation options including:

Carbon Capture, Use and Storage (CCUS). Unlike most other carbon management advisory consultancies, we have a highly experienced team of geoscientists and reservoir engineers who have extensive expertise in gas and CO₂ storage and can augment our knowledgeable in-house surface facilities engineering team to determine specific and optimal sub-surface solutions.

Flaring and Venting Reduction is an important solution to GHG emissions in addition to reducing economic “waste”. GaffneyCline has a track record of providing flaring and venting minimization strategies at a national or company-wide level and often combine this with our ‘Gas and LNG’ advisory service.

Energy Efficiency encompasses a wide range of strategies including waste heat recovery and co-generation. GaffneyCline can provide an integrated and optimized energy efficiency solution to clients.

Integration of Renewables into oil and gas developments. Both from a technical and commercial standpoint, GaffneyCline can support projects whether they be hybrid hydrocarbon and renewables solutions or standalone renewable projects.

Pillar 4. Accreditation of Emissions Reduced

Verification of emissions as part of the development of carbon offsets or carbon credits will become a keystone to future consideration of carbon price on project commerciality.

GaffneyCline will collaborate with existing third-party accreditation bodies to produce our own accreditation where there are gaps in the market such as our proprietary Carbon Intensity rating system, thereby offering a full accreditation service to clients.

Pillar 5. Economic Evaluation of Carbon Reduction

GaffneyCline can use our detailed knowledge of regulatory subsidies, tax incentives and green financing initiatives to produce a range of credible economic assessments and advise on how to make carbon management a source of value creation.

Although GaffneyCline cannot offer the full suite of ESG assessments ourselves we are uniquely placed to collaborate with others or to lead an integrated team to deliver an overall ESG assessment. Our services include defining suitable environmental criteria for ranking investment opportunities and conducting due diligence for potential acquisitions.

GaffneyCline's Energy Transition Credentials

GaffneyCline is an international consultancy that has been offering technical, commercial, policy and strategic advice to the energy sector since 1962. GaffneyCline operates worldwide from three main offices in London, Houston and Singapore and from regional offices in Argentina, Australia and Russia. GaffneyCline employs a combination of technical professionals (geoscientists, engineers) and commercial experts (economics, finance, negotiators, legal and business strategy). Our global sector Practices, Gas & LNG and Carbon Management, are core components of GaffneyCline's international business.

The 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. The key thrust of our Practice is focussed on supporting our clients through the Energy Transition, reducing their risks and enhancing their profitability. We offer a complete Carbon and Climate advisory service to support clients in their Environmental Social and Governance (ESG) assessments.

GaffneyCline experts are at the forefront of development of Carbon Reporting and Carbon Management methodologies; we have been prime movers in the development of various industry standards and regulations. Our Practice leaders have performed key roles in many capability development and technology initiatives including providing the Alternate Chair to the Coordinating Subcommittee of the US National Petroleum Council's Carbon Capture Utilisation and Storage (CCUS) [study](#) and Chair of the CO₂ Capture [Project](#).

We are also considered as a thought leader on the Energy Transition, and we are regularly invited to testify to governments on GHG emissions-reduction technologies. We appear regularly as international conference speakers on Energy Transition topics such as methane management, carbon offsets, hydrogen and CCUS. GaffneyCline has also featured in an Oil and Gas Council investor [podcast](#) on Environmental Social and Governance trends in 2020. We are also asked to contribute to leading energy publications on a frequent basis such as our recent articles in the Petroleum Economist on [carbon audits](#), [Hydrogen](#), and [CCUS](#), and as a member of the Journal of Petroleum Technology (JPT) Editorial Board. A carbon intensity study we contributed to in 2018 was featured in [Science Magazine](#) and a carbon intensity assessment and rating we performed in 2020 was reported in the [Financial Times](#).

Our experience

GaffneyCline has been involved in over 65 energy transition and carbon management studies for clients over the last 2 decades. Over the last few years, we have increased our focus in this space and widened the breath of our technical offer by developing a specific carbon management practice headed by an industry expert.

Due Diligence Projects

Due Diligence of European CCUS Project

Technical assessments of CCUS project taking CO₂ from several refinery and petrochemical facilities including 'blue' Hydrogen Steam Methane Reformers (SMR's) to offshore CCS in depleted gas field in the North Sea. GaffneyCline reviewed all subsurface and surface data and assessed against industry best practice and ISO 27914 for adherence. Provided guidance to immediate clients on risks and uncertainties. Also supported client in discussions with other project partners, ultimately providing technical direction to other project partners.

Carbon Emissions/Intensity Evaluation

Scope 1 and 2 Emissions Assessment plus Carbon Reduction Advice - Argentina

GaffneyCline performed a conduct an independent assessment to estimate the direct and indirect greenhouse gas emissions (GHG) from its operations (Scope 1 and 2), and to identify actions that will enable client to achieve additional improvements to reduce its absolute GHG emissions and its carbon intensity (amount of CO₂ equivalent emissions per unit of product produced).

Carbon Intensity Assessment for the Biscathorpe field in the UK

GaffneyCline performed a Carbon Intensity study on the notional field development plan for Biscathorpe, a UK onshore field. GaffneyCline combined use of the Stanford University Oil Production Greenhouse Gas Emissions Estimator (OPGEE) with data from GaffneyCline's 9000 field database to calculate a Carbon Intensity value for the base case and a range of sensitivities. GaffneyCline then used the database to benchmark the field and used the GaffneyCline Carbon Intensity rating system.

Carbon Intensity Assessment for the West Newton field in the UK

GaffneyCline performed a Carbon Intensity study on the notional field development plan for West Newton. West Newton is a UK onshore field and is at Appraise stage. GaffneyCline combined use of the Stanford University Oil Production Greenhouse Gas Emissions Estimator (OPGEE) with data from GaffneyCline's 9000 field database to calculate a Carbon Intensity value for the base case and a range of sensitivities. GaffneyCline then used the database to benchmark the field and used the GaffneyCline Carbon Intensity rating system to produce an AA rating for the field. In addition, the client was provided with insights on how carbon intensity could be improved from an already high baseline. The Financial Times reported on this study.

Stranded Gas Portfolio Assessment in USA

The client wished to establish a carbon cost per unit of gas for their reserves and resources and then compare this against regional metrics for supply and against the IEA scenarios to ensure that their assets would not be stranded in future due to the energy transition. The scope included calculating both the gas carbon cost per unit and comparing the costs against the relevant IEA scenarios in graphical format and then providing a supporting narrative.

Carbon Disclosure Project, CDP Beyond the cycle: Which oil and gas companies are ready for the low-carbon transition?

A review by GaffneyCline of the top 10 oil and gas companies on their readiness for a low carbon transition as determined by the Carbon Disclosure Project (CDP), found that they all have started reporting carbon intensity of their business. However, no calculation was comparable due to differences in units used, changes in boundaries (operated, operated control, equity), variations in completeness (Scope 1, Scope 1&2, Scope 1,2&3, inclusion of all GHG's or a focus on CO₂ and CH₄), and contrasting approaches to accuracy and transparency (some verified with independent but limited assurance, some internal only). <https://www.cdp.net/en/reports/downloads/3858>

Evaluation of Carbon and Climate Policies

Gas Pricing Regulation Development in Middle East

GaffneyCline in conjunction with a legal firm were engaged to represent an international development institution in connection with a project involving the preparation of a 'Gas Pricing Regulation' for a Middle Eastern country. The purpose was to set out a pricing basis for natural gas in the country in order to encourage the utilization of natural gas and the avoidance of gas flaring and other efficiencies. A roadmap for the elimination of flaring was set out.

Overview of the Voluntary Carbon Market for Major Energy Company

A major energy company has committed to reducing its greenhouse gas emissions to net zero by 2050 and plans to use several strategies to achieve this, including reducing the company's operational emissions and within its supply chains. GaffneyCline provided strategic guidance on net zero attainment including carbon markets and migration of business activities into hydrogen development. The project included:

- Market data on the global voluntary market
- Project development, third-party verification, and characteristics of projects
- Pricing and supply/demand considerations
- Potential costs.

CCS Overview Workshop for Major Investment Bank

GaffneyCline was commissioned to run a workshop to provide an overview of key CCS considerations for senior members of a major international investment bank. The topics covered included: the drivers for adopting CCS; the processes for CCS regulatory environments; and a technical and project overview.



Regulation of Energy Resource Development, Russia

Under EU funding, GaffneyCline worked in consortium to address environmentally acceptable plans for future energy development in the province. The principal objective was to prepare regional energy master plans in the Komi Republic and Nenets Autonomous Okrug (NAO). GaffneyCline highlighted key issues and made suggestions on energy development/utilisation. This involved an assessment of current and future energy supply/demand drivers including the region's hydrocarbon resources; the current domestic energy utilisation mix; and the availability of infrastructure to transport energy within the region. GaffneyCline made field visits to gather data and meet with key energy stakeholders. GaffneyCline's work focused on the following tasks: Komi Republic Energy Master Plan; electricity and heat supply in Naryan Mar; assistance in the development of a Rural Electrification Plan; and an associated Gas Flaring Abatement Study. This latter task provided an overview of the region's gas flaring problems and attempted to identify the main sources and reasons for the flaring and the measures being taken to maximise gas utilisation. A comparison was made with other parts of the world and suggestions presented for improving the overall gas utilisation and quality of flared gas.

U.S Congress Testimony

Testimony on The Future of Advanced Carbon Capture Research and Development.
Description: U.S. House of Representatives Subcommittee on Energy of the House Committee on Science, Space and Technology.
Written testimony available [here](#).

Assessment of Carbon Solutions

Carbon Sequestration (CCS) Project

The study objectives were to obtain an estimate of CO₂ storage potential within Abu Dhabi and identify and assess potential risks. The project identified depleted hydrocarbon reservoirs, shallow unconventional gas reservoirs or saline aquifers which bore the largest and safest potential for CO₂ storage as well provided recommendations for the subsequent in-field injection and related operations.

Carbon Capture Utilization and Storage County Level Technology Outlook in US for the National Petroleum Council

GaffneyCline provided the CCUs Study Alternate Chair to the Coordinating Subcommittee (CSC) and was Lead Author for the Economics Chapter and Roadmap. The US Secretary of Energy requested advice on actions to deploy CCUs technologies at scale in the US. The evaluation of the current state of costs and economics for CCUS implementation across the largest sources of CO₂ emissions that comprised 80% of all stationary sources in the United States, in order to inform the type and level of incentives required to achieve widescale deployment of CCUS. This analysis provided determination of the value of the incentives and the business case needed to enable deployment, the case for RD&D and how this could lead to a reduction of costs, and an economy-wide basis for economic impact assessment with respect to jobs created and GDP added. A roadmap for achieving at-scale deployment over the next 25 years was provided and the results are publicly available at <https://www.npc.org/>

Our experience

Carbon Capture FEED Study Review in UK

For a major Contractor, GaffneyCline acted as Technical Adviser to provide specialist input during the Front-End Engineering stage providing commercial and technical support on the Peterhead and White Rose Carbon Capture and Storage projects. The UK Department of Energy and Climate Change (DECC) had established an Office of Carbon Capture and Storage (OCCS) which required support to cover the full CCS chain from generation to storage and to consider project development, construction, operation, and decommissioning. The technical support provided ensured that OCCS had sufficient technical assurance to enable it to evaluate the two bids and to take a Financial Investment Decision. GaffneyCline were responsible for review of the geoscience, reservoir engineering, wells and offshore facilities and pipeline aspects of the project working in close collaboration with the main contractor who had responsibility to review the onshore facilities. The scope of work encompassed a review of the design basis, monitoring and review of the Front-End Engineering design and evaluation of bids.

Independent Assessment of CO₂ Capture Costs for Selected Louisiana Facilities

Our client was considering an investment in CO₂ transport and sequestration infrastructure in the U.S. Gulf Coast involving carbon capture, utilization and storage (CCUS) projects that source anthropogenic carbon dioxide (CO₂). GaffneyCline carried out an independent assessment of the cost of CO₂ capture from six selected facilities to enable the client understand the economics of what price could be paid for CO₂ offtake in support of the investment.

Field of the Future Blueprint Initial Review of Analysis Insights

GaffneyCline was engaged by an Energy Sector equipment/service provider to advise on the transformation of technology for oil and gas fields with a particular focus on greenhouse gas emissions reduction (GHG's) and how technology solutions may be employed in a "Field of the Future" development concept. The project included detailed assessment of the potential for hydrogen-blend gas turbines.

Assessment of 45Q Tax Credit CO₂ Capture Opportunities along a Major Gulf Coast Pipeline

To support an investment opportunity, GaffneyCline was asked to assess an opportunity to transport and sequester (or use in Enhanced Oil Recovery) CO₂ using a Gulf Coast pipeline system based on applying the U.S. IRS Section 45Q tax credit. GaffneyCline reviewed the CO₂ capture costs (both CAPEX and OPEX) at each facility to determine the amount of revenue that would result from economic investment based on 45Q, LCFS, and/or other incentives at the state/federal level and carbon offset markets.

Assessment of CO₂ Geological Storage Facilities in Russia

GaffneyCline was requested by a Russian client to advise on a CO₂ injection and storage project in Russia, which included injection site selection and development of a concept for safe and efficient storage of CO₂ underground in compliance with ISO 27914:2017 and relevant international standards and EU Directives. GaffneyCline also assessed the potential sites for compliance with the requirements of DNV GL-SE-0473 and DNV GL-RP-J203.

Market Assessment of Carbon Capture Technologies

An assessment of the market (volume and levelized cost) potential through 2050 in different carbon and climate scenarios for all CO₂ capture technology types and various power and industrial applications. Technologies reviewed included those that are currently commercially available such as amine-based chemical absorption, and those at various technology readiness levels (TRL) such as physical separation (sorbents, physical solvents, and cryogenic), membranes (organic and inorganic), and oxyfuel combustion (conventional oxy-firing and novel cycles). This enabled development of a CO₂ Capture technology strategy and implementation plan for the client.



Our experience

Evaluation of CCUS Projects in the U.S. Gulf Coast Region

GaffneyCline was requested by a U.S. private equity firm to assist in the evaluation of a range of investments in the emerging energy transition/carbon management sector which included capture and storage projects. The approach GaffneyCline followed for this assignment included conducting an overview of the emerging Carbon Value Chain and the various business models being applied including the risk profile and key contractual interfaces that are required for suitable risk allocation. GaffneyCline also appraised the carbon capture value chain economics in the context of current and future 45Q tax incentives as well as an assessment of the CCS projects by looking at the upstream part based on CO₂ emissions from a series of gas processing facilities and the downstream part based on capture, aggregation, transmission and storage of CO₂ in the area of interest.

Carbon Capture Technology Investment

Evaluate the market scale and likely price for a carbon capture technology type to underpin investment in a specific company. The evaluation reviewed competitiveness against alternatives and various applications for the technology, along with policy support and integration with CO₂ utilization options that would underpin its deployment.

Carbon Abatement Projects Review as part of a South East Asian Due Diligence

GaffneyCline reviewed two carbon abatement projects for a South East Asian Due Diligence and opined on costs, schedule, and technical scope of work. The projects were membrane improvements to improve methane recovery and the implementation of a gas assisted flare.

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 Enhanced Oil Recovery through CO₂ injection. GaffneyCline then generated a demand forecast for Alberta given a range of oil price, CO₂ price and reservoir suitability.

CO₂ Storage Evaluation in the Middle East

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

Gas Storage Feasibility, West Africa

For a major West African National Oil Company, GaffneyCline reviewed and revised both static and dynamic models for two offshore fields to investigate their potential for gas storage. Potential gas storage volumes, injection and production rates were modelled and the impact on potential late-life oil production was also investigated.

Assistance in the Development of Saline Aquifer Numerical Models

GaffneyCline staff assisted a large Independent Oil Company in its R&D efforts by mentoring users employing the first commercial version of the Eclipse Aquifer module.

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 the basic input data, including fine scale numerical simulation of the slim-tube 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.

Gas Flaring Reduction Project Review in Africa

On behalf an African National Oil Company GaffneyCline reviewed the plans for two proposed gas management projects, both geared towards the handling and treatment of associated gas production to eliminate routine gas flaring. GaffneyCline was asked to review technical feasibility and whether these were in keeping with future gas monetization investment plans. GaffneyCline suggested some further analysis and ideas for alternative gas handling concepts.

Equation of State Modeling for Multi-Contact Miscible Gas Flood EOR Project

GaffneyCline reviewed the PVT modeling carried out by a client in order to generate an Equation of State (EOS) for input to a compositional numerical simulation model of a mature field. The target reservoir was a large Middle East carbonate under mature waterflood. Very successful pilot gas injection projects had previously been completed and the client was planning a significant EOR project in the form of a miscible gas flood. GaffneyCline reviewed the client's work and commented on the suitability of the EOS. GaffneyCline also developed its own EOS using specialist software (MIPVT) to estimate the minimum miscibility pressure (MMP) by numerically simulating slimtube experiments. GaffneyCline estimated MMPs for a range of injectant compositions and advised the client to carry out the simulation forecasts using different EOSs to identify the range of uncertainty. GaffneyCline discussed the multi-contact miscible process with the client and advised on the limitations of compositional simulation of multi-contact miscible processes caused by spatial discretization and numerical dispersion.

Our experience

Accreditation of Emissions Reductions

Gas Flaring Reduction Project Verification in Middle East

GaffneyCline were engaged by a financial institution to provide an independent assessment of a major Middle Eastern gas company's plan to reduce greenhouse gas emissions by expansion of its flared gas capturing, processing, and export facilities. GaffneyCline reviewed the plans to recover and utilize associated gas from three oil fields and verified that the proposed project would reduce Greenhouse gas emissions.

GHG Emissions Regulatory Benchmarking Studies

As part of a regional study on GHG emissions in oil and gas operations in Latin America, GaffneyCline performed a benchmarking of GHG policies and regulations. Policy and regulatory interests in issues related to the climate and GHG emissions were quantified by analysing for each policy or regulation the target, type and scope, status and year of implementation, jurisdiction, and impact on the oil and gas sector. A comprehensive evaluation of 1068 policies, regulations, and laws across Latin America yielded a set of Policy and Regulatory interest indices using proprietary algorithms, which indicate relative levels of effort by respective countries on GHG policy and regulatory fronts. Separate Policy and Regulatory indices were aimed at capturing the differences in how countries formulate and implement their goals.

The benchmarking analysis also considered 587 environmental laws and policies in the United States and Canada. Using our proprietary algorithm to develop the Policy and Regulatory interest indices for each of these countries, a comparison between all the countries considered in the Latin America region as well as the US and Canada to determine efficacy of the policies and regulations in higher ranking countries and how similar approaches may be implemented in lower ranking countries.

Economic Evaluation of Carbon Solutions

Carbon Capture Utilization and Storage Country Level Technology Outlook

A major Middle Eastern National Oil Company requested a country level assessment of the overall unit cost of CCUS for major stationary carbon sources within that nation. This study addressed the entire CCUS value chain from capture and transportation, potential usage, and final storage within suitable saline formations. GaffneyCline identified the storage capacities and locations of saline formations and a storage cost. Appropriate US analogue industries were selected, and location factors applied to create carbon capture cost estimates. GaffneyCline used in-house cost estimating tools informed by outturn data to calculate a transportation cost. Using the base estimates and applying appropriate financial assumptions GaffneyCline then calculated the unit costs and identified an optimized phased development approach for CCUS implementation nationwide.

Gas To Liquids (GTL) Product Study in Japan

GaffneyCline conducted a major review of GTL technology and potential markets for GTL-derived products for a Japanese company. The review considered all aspects of the industry, including a detailed appraisal of the current technologies, identification of likely capital costs, potential areas for technological improvements and potential capital cost reductions. The drivers behind development of the GTL industry were also considered from both project development and market penetration perspectives.

This analysis included an assessment of the drive to monetise stranded gas, the trend towards the elimination of flaring, the impact of tightening refined product specifications and the desire to diversify energy supply in many nations.





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

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