

Gaffney
Cline

Carbon Intensity Expertise



Carbon Reporting Requirements for Energy Sector

We are 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 renewables 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.

Clarifying the potential impact of the low carbon energy transition on oil and gas investments is critical. In 2016, the G20-chartered Financial Stability Board established the Task Force on Climate-Related Financial Disclosures (TCFD) to develop voluntary, consistent, climate-related financial risk disclosures for use by companies to provide information to all stakeholders including investors, lenders and insurers. TCFD published recommendations highlight the need to disclose metrics and targets used for climate-related risk assessment of business activities, for which over 1,400 international organizations with a market capitalization of over \$12.5 trillion have stated their support. TCFD recommendations are also likely to become mandatory in certain jurisdictions; for example, the UK's Financial Conduct Authority (FCA) regulator looks set to shortly require London Stock Exchange premium-listed companies, asset managers and pension funds to comply with TCFD reporting requirements.

Many companies, regulators and markets are therefore using Carbon Intensity (CI) as a key metric to determine carbon and climate performance. The carbon intensity of oil and gas is a key reporting metric (the amount of CO₂ equivalent emissions per unit of energy produced) to assess the carbon performance of oil and gas producers and make more informed choices. A lack of timely action could result in higher compliance costs, price discounts for carbon intensive oil and gas, cancellation of supply contracts and even stranded reserves.

While CI has tended to be reported only on a corporate level, a large variation exists in the CI associated with any specific oil and gas supply-chain given differences in energy use and GHG emissions during the production, transportation and refining of oil prior to end-use combustion of the fuel for transport.

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 bottom's-up portfolio analysis.

Whether it be direct mandatory requirements or a request from investors, CI is moving into the mainstream of TCFD reporting requirements. No matter what size of company, CI needs to be considered alongside other financial and Health Safety Environmental (HSE) performance metrics.

GaffneyCline's Carbon Intensity Services

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.

$$CI = \frac{\text{Total Quantity of Carbon Dioxide Emissions [gCO}_2\text{eq]}}{\text{Total Energy Equivalent of Hydrocarbons Produced [MegaJoules]}}$$

Several factors impact CI including the level of methane emissions, energy requirements and recovery methods used.

For detailed assessments of Upstream GHG Emissions: we use OPGEE (the Oil Production Greenhouse Gas Emissions Estimator). The OPGEE 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 uses a set of approximately 50 inputs for each field to account for GHG emission contributions from all phases and elements of oil supply, i.e. exploration, drilling, production, surface processing and transport to refinery.

For Downstream GHG Emissions: we use PRELIM (the 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 lifecycle energy use and GHG emissions associated with processing a variety of crude oils within a range of configurations in a refinery.

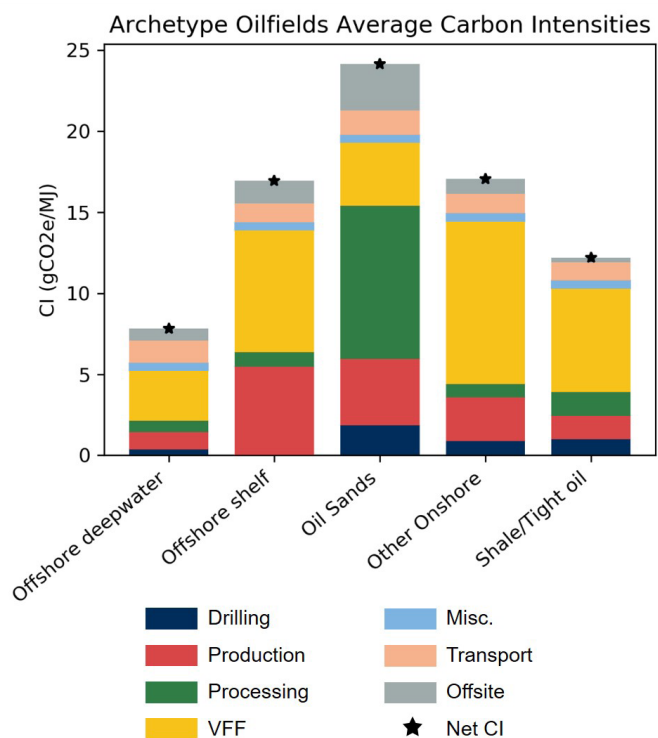
For Carbon Pricing Impact on Reserves: Our CI capability also underpins evaluation of the potential impact of carbon pricing on audited Reserves and Resources by determining the economic impact of various carbon pricing scenarios. This service assists with optimal investment decision making, identification of emissions reduction options, and whether any Reserves or Resources are at risk of becoming stranded.

Climate-change Scenario Assessments: For many companies the most significant impacts of climate change will emerge in the medium to long-term, but the timing and size of the effects are impossible to predict. To appropriately assess the impacts on financial performance the TCFD recommends that organisations need to consider how climate-related risks may evolve and a suitable way to do this is via the use of scenario analysis. GaffneyCline can support our clients with climate change scenario assessments.

For Strategic and Advisory Support Decisions: we offer an overview-level classification system approach based upon recovery, transport and refining methods.

Training on the use of the OPGEE and PRELIM tools is available on request.

Database: For all approaches, we use our database of nearly 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.

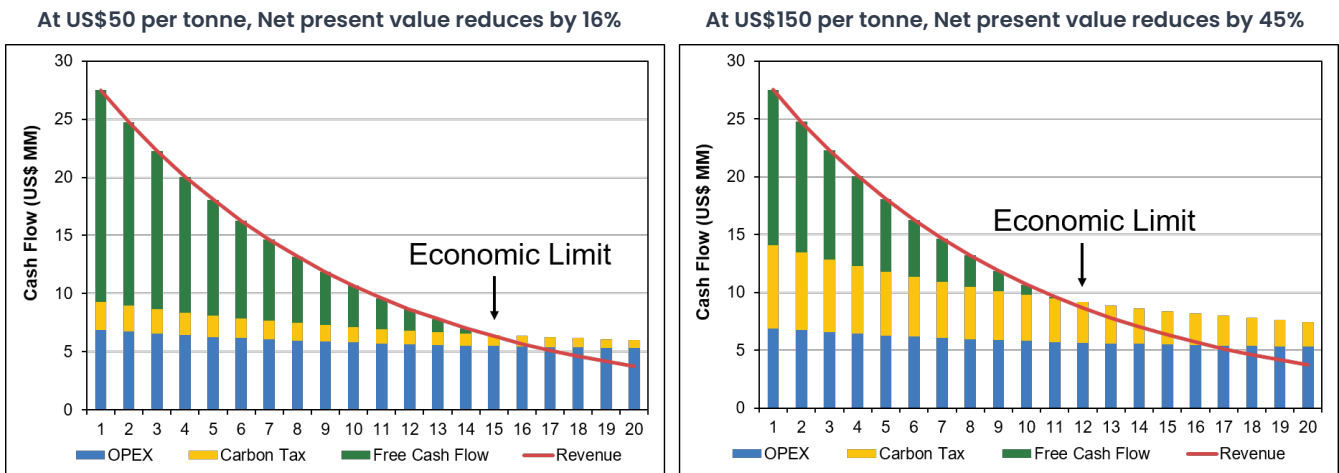


Carbon Pricing Impact on Reserves

Carbon pricing is the preferred methodology for governments to fulfil their obligations under the Paris Agreement. According to the World Bank, 20% of global emissions are currently subject to carbon pricing regulation, ranging from \$1 to \$139/tCO₂e with an average of \$7/tCO₂e. Even in jurisdictions where no such carbon tax is currently in effect, E&P companies are increasingly applying a cost to their future carbon emissions, in order to factor into project economics a hypothetical cost associated with GHG emissions.

In terms of hydrocarbon resources, the impact of applying varied carbon prices as an above ground risk and cost on economic limits and thus Reserves has been evaluated in depth by GaffneyCline. In some situations, an increasing carbon price could substantively reduce Reserves and hasten end of field life with fields exhibiting high Carbon Intensity.

We use OPGEE to estimate the amount of carbon emissions related to oil and gas operations over the lifetime of the asset, and normal cash flow techniques to apply the cost. An illustrative mature onshore oilfield in production decline and with no local gas market can be seen below. Here the life of field production and emissions profiles have an increase in CI over the 20 year span given the lowering volumes of oil production, flaring of associated gas and increasing energy requirements associated with higher water production.



The purpose of the illustrative case study is to demonstrate that factoring in the economics of GHG emissions from the initial decision points of new projects can yield significant value.

- The economic attractiveness of early stage investments can be materially impacted by the cost of future GHG emissions and in turn could result in increased effectiveness of investments, by deploying capital to other resource development.
- The assessment of GHG emissions in development concepts can materially improve project economics and mitigate the lifecycle economic risks of such assets.

We expect this to generate a greater emphasis on reducing a project's CI from very early stages of evaluation, when an operator has the greatest ability to influence the development concept that will ultimately be adopted.

A prudent consideration of the potential impacts of GHG emissions on upstream project economics is essential, starting with an estimation of CO₂e emissions profiles and relying on a broad range of sensitivities to carbon prices.

Such an approach is increasingly warranted to preserve upstream value, rank exploration prospects and mitigate the risks of having stranded assets in a company's portfolio.

Carbon Management Overview

The Carbon Management Practice at GaffneyCline builds on our oil, gas and energy expertise by performing assessment of GHG emissions, and climate-related risks and opportunities. We offer a complete Carbon, Methane and Climate-related Advisory service to support clients in their Environmental Social and Governance (ESG) requirements.

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

1. **Carbon Intensity Evaluations** (the amount of CO₂ equivalent emissions per unit of product) for benchmarking against an existing database of 9,000 fields across 90 countries.
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 manner to ensure continued compliance and competitiveness.
4. **Accreditation of Emissions Reduced** to provide an independent view for stakeholders and enable realization of associated benefits.
5. **Economic Evaluation of Carbon Reduction** to provide an expert view of tax incentives and subsidies and what that means for profitability.



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

About GaffneyCline including 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 Moscow. 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.

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 also appear regularly as international conference speakers on Energy Transition topics such as methane management, carbon offsets, hydrogen and CCUS.

GaffneyCline is 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](#). A paper on the impact of carbon pricing on reserves was featured in 2019 in the International Association for Energy Economics [quarterly review](#) and was presented at the Energy Transitions in the 21st Century conference. A carbon intensity assessment and rating we performed in 2020 was reported in the [Financial Times](#).

Our experience

Carbon Intensity Study

GaffneyCline performed a Carbon Intensity study on the field development plan for West Newton. West Newton is a UK onshore field and is at Appraise stage. GaffneyCline combined use of the OPGEE tool with data from a 9,000 field database to calculate the Carbon Intensity for a range of development plans. GaffneyCline then used the database to benchmark the field and rated it using our system to produce an 'AA' rating for the field, which is consistent with the International Energy Agency's Sustainable Development Scenario.

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.

Climate Change and Scenario Analysis in USA

A client wished to perform a climate change and scenario analysis to determine the potential impact on their reserves of scenarios consistent with limiting global warming to 2°C or below. GaffneyCline's analysis showed that under any scenario, the cost of the client's reserves were well within all International Energy Agency (IEA) climate budget scenarios, including the most stringent Sustainable Development Scenario (SDS). GaffneyCline compared the client's reserve development cost against regional cost of supply that is consistent with the IEA scenarios. The scope included providing graphical result representation and supporting input to the client's online documentation for stakeholders.

Carbon Capture Cost Estimates in USA

A client requested independent technical assessment and feasibility level cost estimates for several refinery and petrochemical facilities. GaffneyCline produced cost estimates including adjustments for location and scaling for size. In addition to conventional amine-based carbon capture schemes novel technology was also considered.

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.

Carbon Capture Utilization and Storage Deployment Analysis

A client requested a country level assessment of the overall cost of CCUS deployment for major stationary emissions sources. The study addressed the entire CCUS value chain from capture and transportation, potential usage and final storage within suitable geologic formations.

GaffneyCline used in-house cost estimating tools and applied financial modelling for determination of an optimized phased development approach for CCUS implementation nationwide.

Gas Flaring Reduction Project Verification in Middle East

GaffneyCline was engaged by an international financial investor to provide an independent assessment of a major Middle Eastern company's plan to invest \$1 Billion to reduce greenhouse gas emissions by capturing and processing flared gas, for use in domestic power generation and export markets. GaffneyCline reviewed the plans and provided a 2nd opinion for Green Financing that the proposed project would achieve a net reduction in Greenhouse gas emissions.

Carbon Capture Utilization and Storage Country Level Technology Outlook in Middle East

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 including an assessment of regional industrial carbon intensities. This study addressed the entire CCUS value chain from production, 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.

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.



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