Gaffney Cline

Energy Transition Practice - Hydrogen Expertise

Hydrogen Market Expansion for Energy Sector

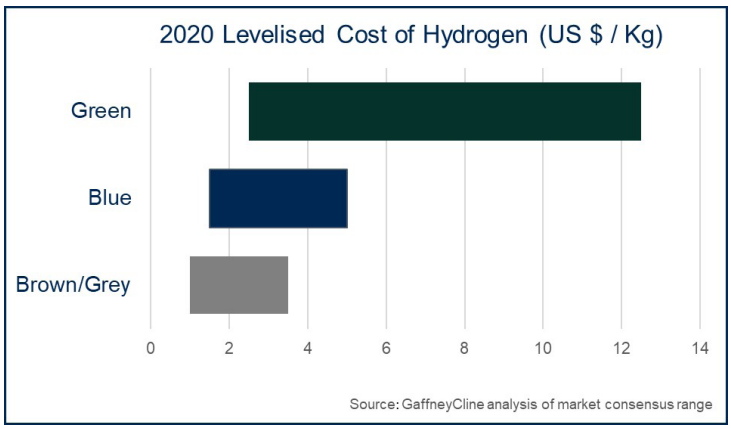
We are facing unprecedented uncertainties in energy markets due to the impact of policies and technologies related to the low carbon energy transition.

To strengthen the global response to the threat of climate change, the COP21 Paris Agreement set a target to keep global temperature increase this century to below 2 degrees Celsius (above pre-industrial levels), and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. As a consequence, a significant reduction in anthropogenic Green House Gas (GHG) emissions is required. Hydrogen has the potential to contribute significantly to the decarbonisation of the energy and industrial markets, and therefore to assist global efforts to meet GHG emissions control requirements.

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 energy industry must be responsive in order to compete with climate policies and societal choices.

In simple terms, the World needs low or preferably zero-carbon energy supplies, and a focus on electrification of the energy market. Electrification, however, does not lend itself to all applications, and Hydrogen provides a solution to those market gaps where a liquid fuel can optimize energy usage in a low or zero-carbon model. Hydrogen is an attractive option to decarbonise those parts of the energy sector where it would be problematic to implement electrification.

In the long-term there continues to be debate about the relative likely contribution from the various ways of producing hydrogen, differentiated by an associated colour palette in reference to environmental credentials relating to their feedstock and production method.



For the short to mid-term, the general consensus appears in favour of investment in Blue Hydrogen (i.e. hydrogen derived from natural gas, plus carbon dioxide emissions abatement), along with movement to an ever increasing contribution of Green Hydrogen (water electrolysis from renewable sources of electricity). Blue Hydrogen will facilitate the transition from liquid fuels derived from high carbon intensity (CI) fossil fuels, to lower CI hydrogen for hard-to-abate sectors. With hydrogen infrastructure in place, supported primarily by Blue Hydrogen volumes, Green Hydrogen can develop commercially to ultimately supplant Blue Hydrogen production, thus moving from abated-low to almost no carbon emissions.

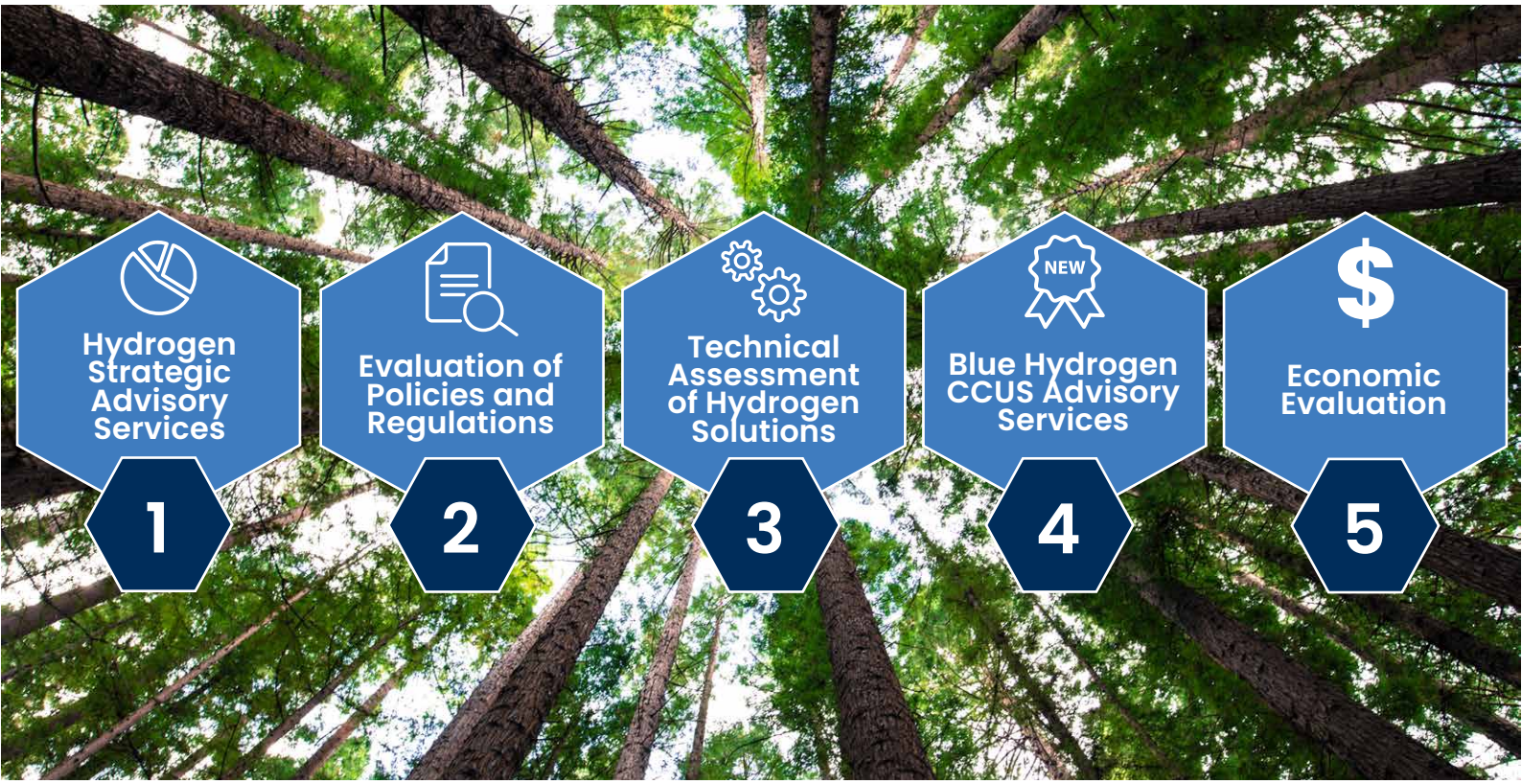
Although hydrogen markets will develop across the globe, the initial development of commercialized hydrogen will be defined by national and trading bloc policies in the major economies. The approach and strategy of each country and/or trade bloc differs, very much aligned with localized availability of energy resources, energy demand and Paris Agreement commitments.

GaffneyCline's Hydrogen Market Services

GaffneyCline's Carbon Management and Energy Transition services complement and build on our oil and gas expertise, by performing technical, commercial and strategic assessments of carbon abatement technologies, in addition to extensive experience in the evaluation and opportunity identification of carbon and climate risks and mitigation strategies. The key focus of our offering is on the provision of Hydrogen studies, Carbon Management advisory services, and Carbon Capture, Utilisation and Storage (CCUS) as core components of GaffneyCline's international energy business.
Our key attributes can be summarized:

- Value Added Approach – GaffneyCline concentrates on understanding the needs and drivers of our clients and then provides customized input to meet those needs.
- International Presence – GaffneyCline's international presence means that we have individuals with key regional knowledge, and a network of experts who can contribute "on-the-ground" global knowledge to any study.
- Integrated Understanding – Unlike many other consultancies who may specialize in specific areas, GaffneyCline is able to offer an integrated approach that considers technical, commercial and policy/ regulatory issues related to Hydrogen and related CCUS.
- Detailed Experience in Hydrogen and related CCUS – GaffneyCline's support to its clients regularly involves analysis of CCUS projects, including those associated with Hydrogen production, across policies, regulations, markets, projects and technology evaluation. GaffneyCline has been involved in over 65 CCUS/CCS screening and feasibility studies for clients over the last two decades. In addition, our experts have been involved in over 27 industry-leading CCUS/CCS projects across the World, plus participation in and leadership of collaborative industry technology development and capability building efforts.

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.



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, along with 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 Energy Transition expertise is a core component of GaffneyCline's international business.

GaffneyCline experts are at the forefront of development of Hydrogen advisory support in addition to Carbon Reporting and Carbon Management methodologies; we have been prime movers in the development of various industry standards and regulations. Our experts 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 CCUS study and Chair of the CO_2 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.

As a committee member, reviewer and implementer, GaffneyCline has been intrinsically involved in the release of the SPE (Society of Petroleum Engineers) development of the Storage Resources Management System (SPE SRMS – SPE CO_2 Storage Resources Management System) publication in 2017. The document, written by a subcommittee of the Carbon Dioxide Capture, Utilization and Storage Technical Section, establishes technically-based capacity and resources evaluation standards for CO_2 geological storage.

With respect to hydrogen, GaffneyCline has undertaken a number of projects focusing on the potential for hydrogen deployment both in terms of cost competitiveness of Blue and Green Hydrogen developments, aspects of CCUS for Blue Hydrogen retrofits and application of Hydrogen in UGS. GaffneyCline regularly produces thought pieces on the subject including the following articles – Levelised costs will settle the blue-green debate and Hydrogen Pathways Depend on Local Circumstances.

Our Experience

Blue Hydrogen Technical Assessment USA

A recent project reviewed 'Blue Hydrogen' Technical Assessment and Feasibility Level Cost Estimate in the USA for a confidential client. The client requested technical assessments and feasibility level cost estimates for several refinery and petrochemical facilities, including for a revamp of 'Grey' Hydrogen Steam Methane Reformers to 'Blue' Hydrogen facilities with carbon capture facilities. GaffneyCline identified the required input data and process flow schemes from publicly available sources and delivered a technical assessment. GaffneyCline then harnessed the latest available reference data to produce cost estimates, including adjustments for location and scaling for size. In addition to conventional amine-based carbon capture schemes, novel technology was also considered.

Carbon Storage Technical Advisor for Government Grant Assurance

For the UK Government Department of Energy and Climate Change (DECC), Office of Carbon Capture and Storage (OCCS) to provide technical assurance to enable it to evaluate two bids and to take a Financial Investment Decision. GaffneyCline provided technical expertise relating to the offshore pipeline & reservoir aspects and worked as subcontractor to a major engineering firm that provided the remaining scope for CO_2 capture.
GaffneyCline's work included a review of the Design Basis of each Bidder's submission for Geoscience, Reservoir Engineering, Offshore Pipeline, Offshore Facilities and Wells to ensure they were technically sound. In addition, GaffneyCline assisted in developing negotiating positions on these issues.

U.S. National Petroleum Council (NPC)

GaffneyCline's Head of Carbon Management took the role of CCUS Study Alternate Chair to the Coordinating Subcommittee (CSC) and Lead Author of the Economics chapter/Roadmap. The study on carbon capture, use, and storage (CCUS) answered the Secretary of Energy's request for advice on the actions needed to deploy CCUS technologies at scale in the United States. This involved alignment of multiple stakeholders. The draft report was approved by the Council's membership in December 2019. The report concludes that at-scale deployment requires strong collaboration between industry and government; improved policies, financial incentives, and regulations; broad-based innovation and technology development; and increased understanding and confidence in CCUS– to create a roadmap for achieving at-scale deployment over the next 25 years.

Carbon Capture Utilization and Storage Country Level Technology Outlook in the 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. The study addressed the entire CCUS value chain from capture and transportation, potential usage and final storage within suitable geological formations. Appropriate analogues were selected, and location factors applied to create carbon capture cost estimates. GaffneyCline also identified storage capacities and locations of saline formations and associated storage costs. GaffneyCline used in-house cost estimating tools informed by outturn data to calculate transportation costs. Using these base cost estimates and applying appropriate financial assumptions, GaffneyCline then calculated the unit costs and identified an optimized phased development approach for national CCUS implementation.

U.S. CCUS Tax Credit Regulations

GaffneyCline was requested by a confidential client to provide a review of the proposed regulations for Section 45Q of the U.S. Internal Revenue Code, and provide input that would underpin its public comments. GaffneyCline also provided its own public comments in 2019 and 2020 on elements of the proposed regulations that relate to monetizing the tax credits in the tax equity market, and reporting and verifying CO_2 geologically stored through appropriate relevant standards and accreditation bodies.

SPE SRMS – SPE CO_2 Storage Resources Management System

GaffneyCline has been intrinsically involved, as committee member, reviewer and implementer, in the release of the SPE (Society of Petroleum Engineers) development of the Storage Resources Management System publication in 2017. The document, written by a subcommittee of the Carbon Dioxide Capture, Utilization and Storage Technical Section (CCUS), establishes technically- based capacity and resources evaluation standards for CO_2 geological storage.

Our Experience

Regional CCUS Hub and Cluster Development in the U.S. Gulf Coast

Provide input to a regional evaluation of CCUS deployment performed by the University of Houston (UH), as part of a broader effort to assess other sustainability issues with other UH researchers and the Center for Houston's Future (CHF). GaffneyCline provided real-world cost information for point source emissions and CO_2 removal investments, and also review of the resulting White Paper.

CCUS Deployment Economics & Roadmap

A confidential client asked GaffneyCline to evaluate the current state of costs and economics for CCUS implementation across the largest sources of CO_2 emissions that comprised 80% of all stationary sources in a country, in order to inform the business cases for large scale deployment and the type and level of incentives required. This analysis provided determination of a phased development plan, the value of the incentives needed to enable deployment, the case for R&D and lead to a reduction of costs.

Market Assessment of CO_2 Capture Technologies

An assessment of the market (volume and levelized cost) potential through 2050 in different carbon and climate scenarios for all CO_2 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 CO_2 Capture technology strategy and implementation plan for the client.

CO_2 Capture Technology Investment

A confidential client asked GaffneyCline to evaluate the market scale and likely price for a specific technology to underpin investment in the company. The evaluation reviewed competitiveness against alternatives and various applications for the technology, along with policy support and integration with CO_2 utilization options that would underpin its deployment.

Levelised costs of Low Carbon Hydrogen Production

GaffneyCline article published in the Petroleum Economist on low carbon hydrogen production costs, including 'Blue Hydrogen' produced by Steam Methane Reformers (SMR's) with integrated CO_2 capture, available here: https://www.petroleum-economist.com/articles/low-carbon-energy/energy-transition/2020/levelised-cost-will-settle-the-blue-green-debate

U.S. Congress Testimony on CO_2 Capture Technologies

Testimony on The Future of Advanced Carbon Capture Research and Development to the U.S. House of Representatives Subcommittee on Energy of the House Committee on Science, Space and Technology. Written testimony available here: https://science.house.gov/download/jenvey-testimony

Hydrogen Pathways Depend on Local Circumstances

GaffneyCline article published in the Petroleum Economist on the differing pathways to Hydrogen market development in the World's major economies: https://pemedianetwork.com/hydrogen-economist/articles/strategies-trends/2021/hydrogen-pathways-depend-on-local-circumstances

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

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