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A large offshore oil rig is shown at sunset, with its lights reflecting on the water. The sky is a mix of orange, pink, and blue. The rig's structure is complex, with a tall derrick and various platforms. A yellow flag is visible on the rig. The overall scene is industrial and dramatic.

**THE CARBON CONUNDRUM –  
HOW OIL & GAS COMPANIES CAN HELP**

**COVER STORY**

# The Carbon Conundrum – How Oil & Gas Companies Can Help

Experts debate the various options before oil and gas companies to pursue the cleaner energy goal.

Oil and gas companies can help address climate change by reducing emissions and investing in carbon removal technologies. The global oil & gas industry is responsible for an estimated 42% of carbon emissions, directly or indirectly. Reducing operational emissions at the wellhead and refineries, improving leak detection and repair, installing vapour-recovery units, and using the best available technology are among the measures that can be implemented by the industry. Investing in carbon capture, utilisation and storage (CCUS) technology is another option that is actively promoted by the International Energy Agency even as critics point out it is unproven and highly inadequate. Others suggest market-based approaches, such as creating financial incentives for carbon removal, which can help drive innovation and attract capital. So against these various available options, how are oil & gas companies rethinking their operational strategies to prioritise carbon emissions reduction?

**When it comes to emission reduction, we are seeing increasing interest in pinch analysis technology**

"Oil and gas companies are increasingly adopting comprehensive strategies to reduce carbon emissions, focusing on both environmental commitments and regulatory compliance. This shift includes the implementation of advanced leak detection systems, vapour recovery units, and significant improvements to operational efficiency throughout the entire value chain, from extraction and transportation to processing and distribution. Companies are also re-evaluating energy use across facilities, aiming to optimise resource allocation and integrate new sustainability standards directly into core operations to meet evolving regulatory requirements and public expectations," says Dr Bijal Sanghvi, Managing Director, Axis Solutions Pvt Ltd. Dr Sanghvi also suggests how his company is dedicated to supporting these



ambitious goals with industry-leading emissions monitoring and detection solutions, which provide clients with real-time visibility into multiple parameter outputs across critical areas such as wellheads, pipelines, and refineries.

Manjunath Rao, Director – Process Industries, Utthunga is of the view that the industrial and energy sector, currently among the largest contributors to the global carbon crisis, is under immense global pressure to reduce emissions of carbon dioxide and methane. "When it comes to emission reduction, we are seeing increasing interest in pinch analysis technology – a transformative new method to optimise energy use in industrial operations. By systematically identifying the 'pinch point' – the location in a system where the temperature difference between hot and cold streams is smallest – this approach maximises heat recovery, minimising the need for external energy sources like natural gas, electricity, or steam. The result is a dramatic reduction in energy consumption, directly translating to lower emissions. Beyond just energy savings, pinch analysis also helps design low-carbon systems by integrating renewable energy sources and enabling waste heat recovery," he emphasizes.

"It's fundamental to understand that there is not a magic solution to promote real decarbonisation in the oil & gas industry; the advances are incremental, and, in this sense, we are seeing good advances. The efforts to maximise energy efficiency of the process, especially in the downstream sector, are a relevant part of the strategic planning of any downstream player and this has a deep impact on carbon emissions. Another good advance is the development of carbon capture



**'Oil and gas companies are adopting comprehensive strategies to reduce carbon emissions'**

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Managing Director, Axis Solutions Pvt Ltd.

technologies and green hydrogen production routes," says Dr Marcio Wagner da Silva, Process Engineering Manager in Brazil. According to him, the oil & gas companies are engaged to reduce their carbon emissions, and this is reflected in their strategic planning, but it's important to consider which is fundamental to look for a balance between carbon intensity reduction and the energetic security of the nations.

Carbon capture and storage (CCS) is considered a short-term solution to climate change whereby captured carbon is stored indefinitely. CCUS, on the other hand, which stands for carbon capture, utilisation, and storage, is a long-term solution to climate change and the captured carbon is used to produce products like plastics, concrete, or biofuel. Both CCS and CCUS are important tools for reducing emissions and combating climate change. They can be used together to create carbon-neutral processes. Now, what role do emerging technologies, such as CCS/CCUS or hydrogen, play in reducing emissions in the oil & gas sector?

"CCUS and H2 are vital in reducing the emissions – capturing carbon at the source helps oil and gas companies increase their



## 'Biofuels are certainly a promising alternative energy source with immense potential'

**Manjunath Rao**  
Director - Process Industries, Utthunga.

spending on exploration while limiting the environmental impacts. Oil and gas companies have existing technologies which might suit CCUS. Green Hydrogen forms less than 1% of H<sub>2</sub> generated and stored; gas is the cheapest option to obtain H<sub>2</sub>, and adding CCS to it forms blue H<sub>2</sub>, and this will enhance the profitability of the oil and gas companies since it diversified their portfolio and opened up new revenue streams. Cutting emissions will be the priority for oil and gas companies – CCUS and H<sub>2</sub> are options worth exploring to build sustainability in operations," explains Dr Shambhu Sajith, Assistant Professor, UPES Online.

Ms Smitha Shetty, Regional Director for APAC at Achilles Information Ltd, opines that while emerging technologies like CCS/CCUS and hydrogen are crucial for driving the energy transition in the oil and gas sector, these technologies are still under development and can be expensive, even as they hold immense potential for significant emissions reduction. "At Achilles, we understand the importance of supporting early-stage innovations in this space. Our approach involves collaborating with industry leaders who are at the forefront of validating new carbon reduction methods. This collaborative effort ensures that we remain informed and aligned with the latest advancements in sustainable practices," she says. The Achilles IOGP Compliance module is a comprehensive, risk-based solution that helps oil and gas companies effectively manage their contractors.

Dr Bijal Sanghvi also believes technologies such as CCS/CCUS and hydrogen fuel are



becoming crucial components in the oil and gas sector's efforts to lower emissions and transition to a more sustainable energy landscape. "CCS works by capturing CO<sub>2</sub> emissions at their source and securely storing them, preventing greenhouse gases from entering the atmosphere, while hydrogen fuel provides a cleaner alternative to conventional energy sources, with minimal emissions at the point of use. Although these technologies hold significant promise, they still face challenges related to scalability, the need for extensive infrastructure, and high costs. Nevertheless, CCS and hydrogen are increasingly viewed as essential solutions in the journey toward a low-carbon future," he asserts.

According to statistics released by Ember, a global energy think-tank, the world has achieved a record 30% share of renewable electricity in 2023 and is well on course to achieve 50% by 2030. So how are companies integrating renewable energy sources (e.g., wind, solar) into their operations to reduce reliance on traditional hydrocarbons?

"While the adoption and recognition of renewable energy sources is witnessing an exponential rise, the high cost of transition continues to be a major roadblock. The only way to combat this is to develop an innovative operational system that combines wind, solar and tidal energy, and explores integration with hydrogen as well," says Manjunath Rao. This includes the installation of solar panels in refineries, usage of solar or wind power to power offshore drilling rigs, solar-driven desalination and water treatment and replacing diesel powered pumps, compressors and other equipment with solar-powered alternatives. "Today, we are also seeing rising adoption of nuclear energy as a reliable, low-carbon source of energy, especially for applications such as offshore platform energy supply and enhanced oil recovery (EOR)," he notes.

According to Dr Marcio Wagner da Silva, the renewables coprocessing routes in crude oil refineries are an interesting route to achieve decarbonisation, but there is a limit considering



## 'Closer relations with clean tech start-ups are beneficial for oil & gas players'

**Dr Marcio Wagner da Silva**  
Process Engineering Manager.

the quality of final derivatives and process restrictions like hydrogen consumption in hydrotreating units and the necessity to develop specific catalysts to deal with high amount of renewable raw material in the feed of processing units. "As quoted earlier, hydrogen is still produced by an intensive carbon emissions route and increasing the renewables participation in the feed of hydrotreating units will not close the circularity cycle. Another key question is ensuring an adequate and secure supply chain of raw materials," he reasons.

## Emerging technologies like CCS/CCUS and hydrogen are crucial for driving the energy transition

"Oil and gas companies have opted for renewables to reduce Scope 1 and Scope 2 emissions. Solar energy is the cheapest form of energy source in most countries now. Solar energy is abundant in oil-rich countries. Substituting the electricity use from fossil fuels with solar energy has been found to reduce costs and increase efficiency. Wind energy has had a cost decline of 23% in the last decade, making it another clean energy option," says Dr Shambhu Sajith. "Hybrid renewable energy solutions have also made their way into the priority list of oil and gas companies. The complementarity between solar and wind will increase the chances of reducing the intermittency challenges associated with renewables," he adds.

For oil and gas companies, any shift from their core business to alternatives is not going to be easy due to a host of factors. What exactly are the challenges and opportunities then, in transitioning to cleaner energy sources like biofuels or green hydrogen?

"The shift towards cleaner energy sources, such as biofuels and green hydrogen, presents both intricate challenges and significant opportunities for the oil and gas industry. Key hurdles include technical issues, like the substantial need for infrastructure adjustments, as well as economic considerations, including high initial investment costs and scalability difficulties," says **Ms Smitha Shetty**. "At Achilles, we are committed to facilitating this crucial transition by enhancing transparency within supply chains and connecting oil and gas companies to a vetted network of environmentally conscious suppliers through our Achilles Network model and Carbon Reduce Programs. This structured approach to supplier management empowers companies to confidently navigate the evolving energy landscape, bolstered by access to a reliable network of sustainability-focused partners," she informs.

### The complementarity between solar and wind will increase the chances of reducing the intermittency challenges

**Dr Bijal Sanghvi** agrees that this presents a range of challenges, including high production costs, significant infrastructure requirements, and the development of appropriate regulatory frameworks. "Despite these obstacles, biofuels and green hydrogen offer immense potential to reduce greenhouse gas emissions, diversify energy sources, and help companies align with global sustainability and climate goals. These energy alternatives play a pivotal role in reshaping the future of energy production, contributing to a more resilient and sustainable energy mix," he suggests. "By leveraging innovative solutions, companies in the energy sector can navigate the complexities of this transition with confidence, optimising production processes, improving efficiency, and ensuring high-quality outputs that contribute to a successful, sustainable energy future," he adds.

"Biofuels are certainly a promising alternative



energy source with immense potential to transform India's energy strategy. However, unlocking this potential depends largely on government support to raise the permissible blending percentage. When it comes to green hydrogen, the key challenge lies in the high investment costs and the safety risks associated with its handling, particularly given its high explosivity," says **Manjunath Rao**. "While technological advancements and innovations are progressively developing components that will help lower costs, the real breakthrough will come when market demand increases. As the market matures and costs come down, hydrogen will emerge as one of the most viable energy options available," he opines.

For oil and gas companies, it is not going to be an easy transition on their own. How important are partnerships between oil & gas companies and clean tech startups or government initiatives in driving emissions reduction?

"This synergy is fundamental! As previously quoted, there are no clear policies about carbon markets in countries and incentive policies to install carbon capture technologies by the oil & gas players, it's a fundamental part of the strategy to promote real decarbonisation without great impact over the energy cost for final consumers," says **Dr Marcio Wagner da Silva**. "Closer relations with clean tech start-ups are beneficial for oil & gas players once these companies have more agility and experience in developing and launching new technologies. As a secular industry, oil & gas companies tend to have extremely rigid management processes which can delay the development of innovations, and the start-ups partnership can be a strategy to solve this matter," he elaborates.

To **Dr Shambhu Sajith**, innovation in the energy sector is never-ending, and staying afloat in the industry by experimenting, innovating, and pouring in research and development funding is essential. "Partnering with startups would bring more opportunities to oil and gas majors.



### 'Oil and gas companies have opted for renewables to reduce Scope 1 and Scope 2 emissions'

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Assistant Professor, UPES Online.

Startups bring agility and innovation, often developing breakthrough technologies like carbon capture, energy efficiency, and renewable energy integration. Chevron partnered with Carbon Clean, a clean tech startup, to develop compact carbon capture technologies for industrial applications. Often, the adoption of new technologies comes with additional risks. Co-funding projects spread financial, environmental, social, and political risks, creating more room for developing and testing new technologies. ExxonMobil partnered with Global Thermostat to pilot advanced carbon capture systems, a prominent example," he explains.

"Achieving meaningful carbon reduction goals requires a collaborative approach, bringing together key players across the energy landscape. Through the Achilles network model, oil and gas companies gain access to a pool of vetted suppliers committed to compliance and sustainability," says **Ms Smitha Shetty**. "Furthermore, the Achilles Carbon Reduce Program powered by Toitū Envirocare provides independent verification of emissions reductions and ensures transparent environmental impact metrics. This fosters trust and accountability, encouraging collaborative action and accelerating progress towards a lower carbon future," she adds.

What specific processes or operational changes are being implemented to improve energy efficiency and reduce emissions at extraction, refining, and transportation stages?

**Dr Bijal Sanghvi** believes that to improve energy



efficiency and significantly reduce emissions, companies across the oil and gas sector are increasingly adopting advanced automation technologies, vapour recovery systems, and comprehensive emissions monitoring solutions at every stage of their operations. "These innovative approaches help optimise extraction processes, enhance fuel efficiency in transportation, and improve the overall operational efficiency of refining, all while reducing the carbon footprint of the industry and supporting alignment with global sustainability goals," he says.

"Currently, alternate fuels such as water, air, tidal, biogas and hydrogen, are being utilised to reduce emissions across all states. Moreover, technology developments like predictive emissions management, IIoT and AI/ML will help companies across all functions in the oil and gas supply chain to better plan, understand and optimise their emissions," says **Manjunath Rao**. According to him, at the extraction stage (upstream), smart rigs can utilise AI/ML, advanced sensors, automation technologies and real-time monitoring to reduce energy consumption and improve operational efficiency. In the downstream phase, CCUS is making tremendous waves in reducing the carbon footprint of refineries. "The use of

combined heat and power (CHP) systems to generate electricity from excess heat will also optimise heat recovery systems and lower fuel consumption. Advanced Process Control (APC) systems are also absolutely critical for the real-time adjustment of variables like temperature, pressure, and flow rates to improve energy efficiency and reduce emissions, while also ensuring the production of high-quality products," he explains.

For **Dr Marcio Wagner da Silva**, the main question is using the available technologies to promote deep studies of the process and identify opportunities to reduce energetic intensity of the process. "A question which demands even more study is hydrogen waste in crude oil refineries where the use of 'pinch technologies' can help the refineries to minimise the carbon emissions related to hydrogen production," he says.

To conclude, **Dr Shambhu Sajith** makes the following observations:

- At the extraction stage, it is evident that renewable energy technologies should be employed to reduce Scope 1 and 2 emissions. The adoption of digitalisation and automation has been found to increase efficiency. They use real-time data to simulate and optimise



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extraction processes, minimising energy use and emissions.

- At the refining stage, conventional boilers and furnaces should be replaced with advanced heat exchangers and high-efficiency heaters, and waste heat from one refining process should be utilised to power another. Reducing energy waste is found to be effective.

## A question which demands even more study is hydrogen waste in crude oil refineries

- We have seen tanker quality improve at the transportation stage, emitting less CO<sub>2</sub>, SO<sub>2</sub>, and NO<sub>x</sub>. Fleets have become hybrid, and there are many more inroads of H<sub>2</sub> and electric ones.

*Note: The responses of various experts featured in this story are their personal views and not necessarily of the companies or organisations they represent. The full interviews are hosted online at <https://www.iedcommunications.com/interviews/>*

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