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Strategic Framework for Oil and Gas Companies to Deliver Net-Zero Goals

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Abstract— *The paper presents a strategic framework that oil and gas companies can use in their journey towards the Net Zero target, incorporating the reduction of operational emissions, control of methane leaks, and transformation of investment portfolios by leaning towards low-carbon technologies. This is relevant because the company's Scope 1–2 operations have emissions exceeding 5.1 Gt CO_2-eq. and about 120 Mt CH_4 per year, to be reduced by at least 50% as per the IEA Net Zero by 2050 scenario sometime before 2030. An integrated methodology that brings together regulatory mechanisms (IFRS S2, SEC rules, CBAM, ETS, EU Methane Regulation), financial incentives (IRA, tax credits), technological solutions (CCUS clusters, hydrogen-ammonia hubs), and digital tools (satellite monitoring, LDAR programmes AI optimization) is herein promulgated as an action plan. The uniqueness of the method comes from a structured look at global reports, company examples, and industry figures to create a complete "measuring – assessing– investment – optimization" cycle all about decarbonization. The key results show that joining CCUS centers and hydrogen plans with digital systems and innovative financial tools allows for two-digit cuts in emissions over the medium term, turning one-time CAPEX projects into an ongoing improvement process while also ensuring the strength of the entire plan. This article will be of value to strategic planning and sustainability executives in oil and gas companies, as well as to consultants and investors engaged in energy-sector decarbonization.*

Keywords— *Oil and gas industry, Net Zero, strategic framework, CCUS, hydrogen, carbon pricing, methane, digital monitoring, low-carbon investments.*

I. INTRODUCTION

The global shift toward "Net Zero" already encompasses the majority of the world's economy and population: by September 2024, 148 nations had formal Net Zero targets in place, representing 93% of global GDP (PPP), 87% of current greenhouse-gas emissions and 88% of the population, with 73% of these commitments codified in law or government policy [1]. Nevertheless, the gap between promises and emission-reduction trajectories remains critical: according to UNEP, to limit warming to 1.5 °C, the world must cut emissions by 42% by 2030—an average annual reduction of 7.5% over the coming decade [2].

Against this backdrop, the oil and gas sector plays a dual role as both a key energy supplier and one of the most significant sources of greenhouse gases. In 2022 alone, upstream, transportation, and processing operations (Scope 1–2) produced approximately 5.1 Gt CO_2-eq., equivalent to nearly 15% of all energy-sector emissions; the combustion of solid hydrocarbons contributes an additional ~40% [3]. The challenge is further exacerbated by methane: in 2023, fossil fuel production and consumption released on the order of 120 Mt CH_4, and the energy sector accounts for more than one-third of anthropogenic methane emissions [4].

The IEA's Net Zero Emissions by 2050 scenario sets clear targets: by 2030, specific operational emissions must be reduced by at least 50%, yielding a total sectoral emissions decline of 60% even without demand reductions; global energy needs can be met without developing new fields beyond those already sanctioned [3]. These parameters define a stringent corridor for oil and gas strategies: companies must simultaneously curtail operational emissions, rigorously manage methane, and reorient their investment portfolios toward low-carbon technologies. The framework proposed in the following sections addresses this multidimensional challenge by integrating technological, financial, and regulatory tools into a unified industry action plan on the path to Net Zero.

II. MATERIALS AND METHODOLOGY

This study of a strategic framework for oil and gas companies to achieve Net Zero goals is founded on analyzing 28 sources, including international reports, climate-disclosure standards, corporate annual reports, and regulatory documents. The theoretical basis comprises the Net Zero Stocktake 2024 and the UNEP Emissions Gap Report, which outline global commitments and required emissions-reduction trajectories [1, 2], as well as IEA analytical materials on operational and methane emissions and the Net Zero by 2050 scenario [3, 4]. Regulatory frameworks were examined through IFRS S2 and SEC rules [5, 6], CBAM and ETS mechanisms [7], the EU Methane Regulation, and global methane-reduction commitments [8, 9].

The technological analysis drew on OGCI data concerning investments in low-carbon technologies [14], IEA reviews of CCUS and low-carbon hydrogen projects [17, 18, 21, 22], and corporate case studies from BP, Shell, Equinor, and ExxonMobil [10, 11, 12, 13]. The digital component of the methodology included a systematic review of GHGSat satellite-monitoring data and UNEP's MARS dataset [23, 24], an evaluation of Shell's LDAR programmes and ExxonMobil's COMET systems [25, 15], and an investigation of BP APEX and Cosmo Oil AI solutions [27, 28]. Methodologically, the work employs a systematic review and content analysis of regulatory and industry documents, a comparative technological and financial analysis, and the development of matrices linking regulatory drivers, carbon-price signals, and technological solutions to formulate an integrated strategic framework.

III. Results and Discussion

The global push for unified climate disclosures has now entered the implementation phase. The ISSB's IFRS S2 standard, which was released in June 2023, will be required for reporting periods that start after January 1, 2024. By November 2024, 30 jurisdictions had declared their intention to adopt or get ready to adopt the standard, which together represent 57% of global GDP and over half of worldwide emissions. More than 1,000 companies have explicitly referenced the ISSB in their annual reports [5]. In parallel, on 6 March 2024 the U.S. Securities and Exchange Commission approved its own climate-disclosure rule; it mandates the publication of material risks, internal carbon-price assumptions and, for the largest issuers, Scope 1–2 data, phasing in from 2026 reporting onward and already reshaping investor information requests despite ongoing litigation over the SEC's authority [6]. Together, these regulations establish the foundation on which oil and gas companies must rely when setting the targets and KPIs described in earlier sections.

Carbon-price signals are likewise becoming more stringent. The EU's transitional CBAM regime has been in effect since 2023, with full implementation slated for 2026; the levy will be applied to the embedded CO_2 content of imports, directly affecting petrochemical value chains. At the same time, global carbon-pricing revenues set a new record: according to the World Bank, revenues from 75 operating carbon-pricing schemes reached USD 104 billion in 2023 [7]. For oil and gas firms, this implies accelerated monetization of the energy transition: an internal carbon price below a certain threshold will no longer cover future CBAM obligations and regional ETS costs.

Alongside regulatory frameworks, incentives and voluntary coalitions are strengthening. The Inflation Reduction Act (IRA) expanded the United States' investment and production tax credits. In 2025, even some members of the congressional Republican wing publicly supported their continuation, acknowledging their critical role in in-state energy projects. The first EU Methane Regulation in Europe was enacted in August 2024, banning routine flaring and imposing import-transparency requirements for external suppliers' leak data [8]. Over 160 nations have signed the Global Methane Pledge, agreeing to work together to cut methane emissions by at least 30% from 2020 levels by 2030 [9]. Figure 1 illustrates global methane emissions from fossil fuel operations: the orange line indicates that, under a business-as-usual trajectory, emissions would remain at roughly 110–112 Mt CH_4, whereas the Net Zero scenario projects a decline to about 30 Mt by 2030. Existing policies deliver approximately a 20 Mt reduction, national pledges add around 35 Mt, and closing the gap to the Net Zero target requires an additional ~25 Mt of measures.

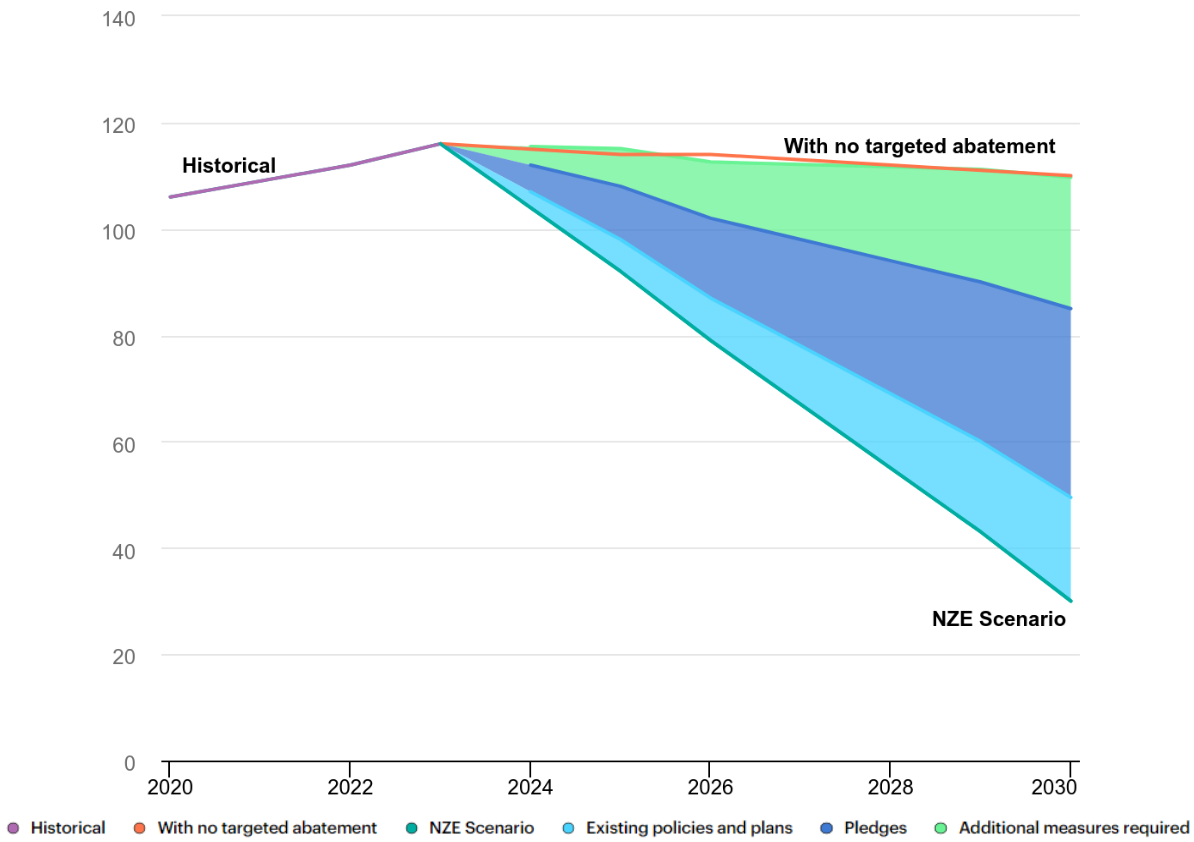

Fig. 1. Reductions in methane emissions from fossil fuel operations from existing policies and pledges, 2023-2030 [9]

The combined effect of tax incentives, carbon-pricing mechanisms, and alliances creates an external "compression framework" in which mere compliance no longer confers competitive advantage; strategic value shifts toward early fulfilment of requirements and integration of both operational and supply-chain emissions, logically leading to the solutions proposed in subsequent sections.

With disclosure rules tightened and direct carbon-price signals in place, companies are reallocating capital expenditures to preserve returns while meeting Net Zero commitments. At British BP, "transition investments" remained at USD 3.7 billion in 2024, 23% of total CAPEX, essentially unchanged from 2023 and seven times higher than in 2019 [10]. Shell shows the opposite trend: total investments of USD 21.1 billion included just USD 2.4 billion for low-carbon activities in 2024, down from USD 5.6 billion (23% of the budget) the year before. This change is a result of the revision of offshore wind and the halt of significant biofuel initiatives [11]. Figure 2 shows that Shell's aggregate GHG emissions (Scope 1, 2, and 3) declined from 1,615 Mt CO_2-eq. in 2016 to 1,122 Mt in 2024, with a planned trajectory to net zero by 2050. Emissions fell in stages—to 1,220 Mt in 2022, 1,158 Mt in 2023, and 1,122 Mt in 2024—demonstrating ongoing Net Zero strategy implementation.

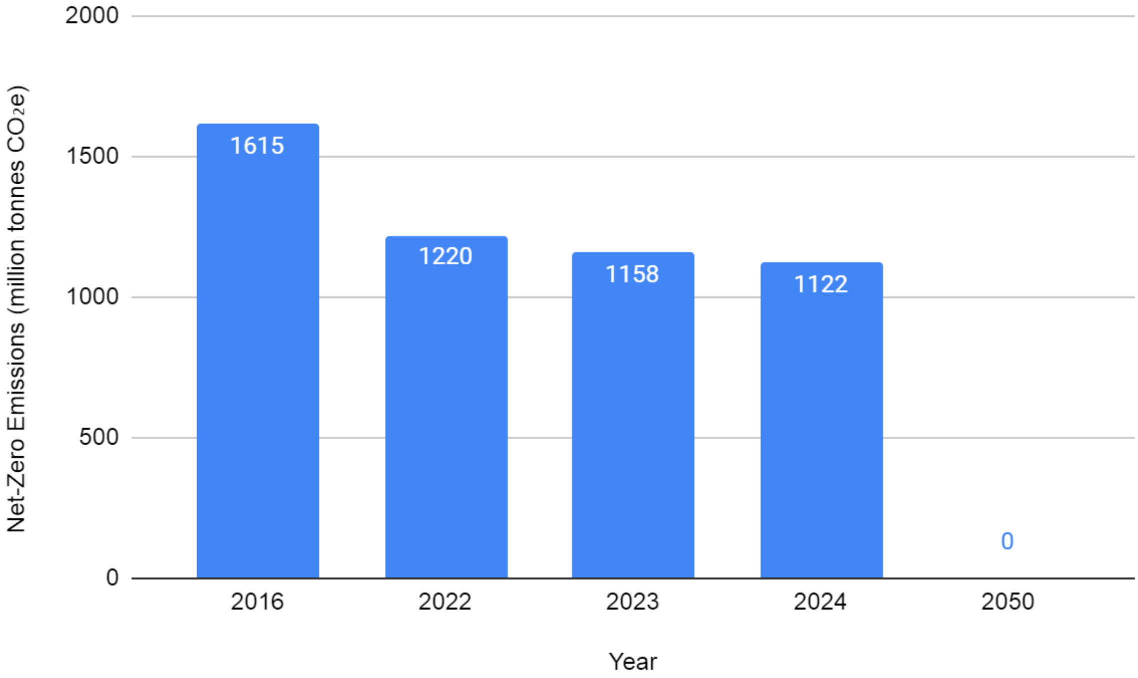

Fig. 2. Shell's net-zero emissions by 2050 [11]

TABLE 1. OGCI Low-Carbon Investment and R&D Indicators [14]

OGCI indicators	Units	2017	2018	2019	2020	2021	2022	2023
Total spent in low carbon projects (sum of total spent in low carbon projects and acquisitions of low carbon activities)	$ billion	4.7 (10)	5.5 (10)	5.6 (10)	6.8 (11)	13.3 (10)	24.2 (11)	27.7 (11)
of which acquisitions	$ billion	0.3 (5)	1.0 (5)	1.1 (9)	1.6 (9)	7.7 (9)	13.2 (10)	7.1 (9)
R&D expenditures on low-carbon technologies	$ billion	0.7 (9)	1.0 (9)	1.0 (9)	0.8 (11)	1.3 (11)	1.7 (11)	2.0 (11)
Low-carbon R&D as a share of total R&D spend	%	19.0 (9)	15.0 (9)	15.0 (9)	11.7 (10)	17.3 (11)	30.2 (11)	35.4 (11)

Equinor has maintained its diversification course but adopted a more cautious stance: in 2024, only 16% of gross investments were directed to renewables and low-carbon solutions, down from 20% two years earlier [12]. Against this backdrop, ExxonMobil allocates minimal CAPEX to green projects. Still, it has announced up to USD 30 billion of low-carbon investments between 2025 and 2030, focusing on CCS and blue hydrogen in the United States [13].

A comparable change is seen in aggregated OGCI data: in 2023, the alliance's twelve members invested a historic USD 29.7 billion (+15% year-over-year) in low-carbon technologies. However, most funds went to acquisitions rather than organic growth, reflecting caution in scaling projects amid volatile carbon prices [14]. Renewable energy accounted for over half of the investments. Notably, companies reported more organic capital directed to these projects than the previous year, which was marked by significant acquisitions. CCUS investments continued to rise, with several members concentrating on the technology within their emissions-reduction strategies. Low-carbon R&D spending increased by 17% in 2023 to USD 2 billion, representing 35.4% of total R&D outlays. Table 1 illustrates that since 2017, the OGCI members have invested a total of USD 95.8 billion in low-carbon technologies and initiatives, including capital expenditures, research and development, and acquisitions.

Methane remains the litmus test for companies' readiness to secure "quick wins." By 2023, OGCI had achieved an average leak intensity of 0.14% (target < 0.20 %) and set a course toward "near-zero" by 2030 [14]. BP confirms its leadership: under a new measurement protocol, its leak intensity was 0.07% in 2024, three times below the Oil & Gas Decarbonization Charter threshold [10]. ExxonMobil is scaling its multimodal COMET monitoring system, combining continuous sensors with satellite validation, from the Permian Basin to its global upstream portfolio [15]. Industry-wide, by March 2024, the Decarbonization Charter, which aspires to zero leaks by 2030, had united 52 oil and gas companies controlling 44% of global oil production [16].

A comparison of investment and methane metrics reveals a widening gap between low-cost operational emission reductions and capital-intensive portfolio shifts. While low-carbon CAPEX is growing too slowly to meet 1.5 °C trajectories, LDAR programmes demonstrate that targeted technology solutions can rapidly reduce climate risk, creating space for the more profound transformation outlined in the subsequent framework sections.

Under current pathways to 1.5 °C, two technology streams—CCUS and low-carbon hydrogen (including ammonia)—offer oil and gas companies the means to rapidly cut Scope 1–2 emissions where direct electrification remains economically or technically unfeasible. By early 2025, just over 50 Mt/y of CO_2 capture capacity was operational, yet the project pipeline through 2030 exceeds 430 Mt—eight times current levels—across more than 700 CCUS initiatives; in 2023, announced 2030 capacity grew 35% year-on-year, and some 45 commercial facilities are under development, spanning power plants, refineries and fertilizer production, with nearly one-third of new projects tied to oil and gas operations [17, 18].

A key scaling driver is the "cluster" model featuring shared pipelines and storage sites. The Houston CCS Hub—led by ExxonMobil, Chevron, and Occidental—is projected to sequester up to 100 Mt CO_2/y by 2040 into Gulf Coast salt domes [19]. In Europe, the first phase of Northern Lights commenced operations in September 2024 with a 1.5 Mt/y capacity and expansion potential [20]. Such hubs sharply lower the capital threshold for individual firms and establish a nascent carbon-storage service market.

Concurrently, interest in the hydrogen value chain is rising. According to the IEA, final investment decisions have been taken for electrolyzers totaling 20 GW, of which 6.5 GW were approved in the past twelve months; over 40% of FIDs are in China, home to large-scale electrolyzer manufacturing [21]. In the blue-hydrogen arena, where natural gas feedstock is paired with CO_2 capture, U.S. projects dominate, supported by the 45Q tax credit increased to USD 85/t of CO_2 captured. In November 2024, DOE awards of up to USD 1.2 billion for the Gulf Coast HyVelocity Hub and USD 1 billion for Midwest MachH2 triggered private co-investments and guaranteed offtake for low-carbon H_2 [22].

Thus, CCUS clusters and hydrogen-ammonia hubs form a complementary technology system: the former line mitigates residual emissions from extraction and processing. At the same time, the latter expands markets for blue and green hydrogen, reducing asset-level carbon risk. Their integration enables companies to move from incremental intensity improvements to a trajectory aligned with Net Zero, logically leading to the next component of the proposed framework—an integrated financial architecture and supply-chain partnerships.

A reliable path to Net Zero begins with accurate emissions measurement. Satellite monitoring has been the breakthrough of the past two years: commercial operator GHGSat deployed 12 satellites that, in 2023, conducted over 3 million observations across 85 countries and detected nearly 16,000 large methane plumes at oil and gas sites [23]. These data feed directly into UNEP's MARS system, which by late 2024 had issued 1,200 alerts to governments and companies about critical leaks. However, only about 1% of signals have led to timely remediation [24]. This gap between detection and response underscores that digital transparency is adequate only when paired with robust internal procedures and incentives for rapid leak repair.

At the facility level, industry leaders now integrate external imagery with continuous sensor networks and machine-learning algorithms. Shell's LDAR programmes, for example, covered 80% of its upstream and LNG assets by the end of 2023; the company deployed an AI module capable of localizing persistent methane sources from 0 to 5 kg/h and automatically prioritizing them for repair [25]. Combining on-site sensors, drones, and satellite validation creates an end-to-end data stream suitable for IFRS S2 reporting and dynamic internal carbon pricing.

The next layer of digital transformation is AI-driven process optimization. The IEA reports that the number of supercomputers in the oil and gas sector rose from 11 to 24 between 2000 and 2024, with computing power increasing nearly 70% annually; under wide deployment, such technologies could deliver up to USD 110 billion in annual fuel-use savings by 2035 [26]. Practical cases already confirm this potential: BP's APEX digital twin on Azure enables real-time tracking of process carbon intensity and promises up to 500 kt CO_2-eq. savings per year at full scale [27]; at Cosmo Oil's Japanese refineries, real-time crude-distillation optimization yields over USD 2.3 million in annual savings per unit with payback under 12 months, while reducing specific energy use and thus emissions [28].

Accordingly, digital solutions bridge two critical gaps in the Net Zero transition: they render post-facto emissions inventories transparent for investors and regulators, and provide operational "vision" for immediate leak remediation and predictive models to dynamically balance energy and carbon profiles. Combined with the CCUS clusters and hydrogen hubs described above, these systems transform decarbonization from a one-off CAPEX project into a continuous optimization cycle, the central element of the proposed strategic framework.

Companies establish a set of discrete measures and a unified, adaptive decarbonization ecosystem through the mutual integration of CCUS clusters, hydrogen-ammonia hubs, and advanced digital tools. Each component reinforces the others: satellite monitoring and AI algorithms swiftly detect and triage leaks; CCUS modules capture residual emissions; and hydrogen production and transport hubs secure the economics of large-scale low-carbon investment. This coordinated approach converts carbon-reduction projects from one-time CAPEX initiatives into a permanent cycle of continuous improvement, enabling companies to progress steadily along a Net Zero–compatible trajectory.

However, full deployment of this technology system requires the next, equally vital level—a robust financial architecture and reliable supply-chain partnerships. Only structured financing mechanisms, innovative carbon-risk insurance tools, and thoughtful coordination across production and service chains can ensure these solutions' long-term viability and scalability. In the Conclusion, we examine how systemic financial models and industry alliances close the decarbonization loop, turning strategic technologies into a practical pathway to Net Zero.

IV. Conclusion

In the context of escalating climate uncertainty and stringent international commitments to achieve Net Zero, oil and gas companies must develop multi-layered strategies that address technical but also regulatory, financial, and digital dimensions. The strategic framework proposed in this article establishes a unified methodology, integrating climate-disclosure requirements, carbon-price signals, and incentive measures from governmental and voluntary mechanisms. This gives companies a clear aim-setting standard that matches global rules (IFRS S2) and SEC needs. Also, CBAM, stricter methane laws, and internal carbon pricing will soon start.

A foundation of the plan is the set of tech tools capable of delivering two-digit emissions cuts in the medium term. Growing CCUS groups and making hydrogen-ammonia centers allow the conversion of leftover emissions from making and handling into marketable goods while also reducing carbon risk at the asset level. Such technologies, implemented via consortia like the Houston CCS Hub and Northern Lights, can lower entry barriers and create collective CO_2 storage and utilization infrastructure.

Equally critical is digital transformation: the combination of satellite monitoring, continuous-sensor LDAR programmes, and AI algorithms unlocks new levels of transparency and rapid response to leaks. The integration of GHGSat data with in-house machine vision systems allows companies to fulfill Scope 1–2 disclosure obligations and to deploy predictive models that optimize energy balance in real time. Digital platforms such as BP APEX and Cosmo Oil's systems have effectively reduced specific fuel consumption and generated significant CO_2-equivalent savings.

The proposed framework's systemic strength lies in its capacity to amalgamate disparate measures into an adaptive decarbonization ecosystem, transforming one-off CAPEX projects into a continuous optimization cycle. However, sustaining this process requires sophisticated financial instruments, structured carbon-risk insurance, and dependable supply-chain partnerships. Implementing such systemic financial models completes the decarbonization cycle, providing oil and gas companies with a tangible and verifiable pathway to their Net Zero goals.

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