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# Financing the Petroleum Industry in an Energy Transition Landscape

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## Abstract

The objective of this study is to discuss the reasons for financing the petroleum industry in an energy transition landscape and the structures that could be used to finance this industry while stimulating energy transition. This article is grounded mainly in scholarly literature from law and economics and regulatory law and places them in the perspective of ESG and energy transition literature. The main methodology adopted for this study was review and discussion of scholarly work. The results obtained indicate that since the shifting from fossil fuels to renewable energy sources is a long-term process that requires changes to infrastructure, policy, and market dynamics, and that traditional regulatory tools often struggle to effectively support this transition, using financing instruments connected to the petroleum industry is crucial to stimulate the required sustainability goals, particularly considering that the performance of the petroleum industry is key to the energy transition. The implications of this study are significant for scholars, policymakers and private agents. The petroleum industry is one of the most capital-intensive industries in the world and anything that affects its financial capacity impacts its behavior and may be used as a tool to reduce global greenhouse gas emissions.

## Keywords

Financing Instruments, Petroleum Industry, Energy Transition

## 1. Introduction

The petroleum industry remains one of the cornerstones of the global economy with revenues reaching significant levels in recent years. In 2024, the industry's market size was estimated at approximately 7.75 trillion dollars, with projections indicating growth to 8.18 trillion dollars in 2025, reflecting a compound annual

growth rate (CAGR) of 5.6 percent (Business Research Company, 2025). In terms of profitability, the global oil and gas industry earned a record income of more than 2.4 trillion dollars in 2023 (Energy Profits, 2025).

The petroleum industry is also one of the most capital-intensive industries in the world, requiring massive upfront investments in exploration, drilling, refining, transportation, and distribution. The high capital costs result from the need for complex infrastructure, long project lifecycles, and high technological requirements.

New entrants struggle to compete with large oil companies that control infrastructure and resources. Usually, only multinational oil majors (ExxonMobil, Shell, BP, etc.) or state-owned oil firms (Saudi Aramco, Petrobras, etc.) can afford large-scale projects.

Oil price fluctuations impact capital investment. During high oil prices there are more investments in exploration and production, while during low oil prices, companies cut capital spending and delay projects. That's one of the reasons why oil companies are increasingly focusing on cost efficiency and digitalization to improve returns and mergers and acquisitions are a common strategy to reduce costs (e.g., ExxonMobil acquiring Pioneer Natural Resources).

While the petroleum industry continues to experience robust revenues, it is also navigating challenges such as market volatility, geopolitical tensions, and the global shift toward sustainable energy sources (energy transition). These factors are influencing strategic decisions and investment priorities within the sector.

The global energy transition represents the largest capital reallocation in history, surpassing even the industrial revolution and the digital transformation. This shift is being driven by the need to decarbonize the economy, transitioning away from fossil fuels, and investing in renewable energy, electrification, and new energy technologies. Please see below a comparison between energy transition and previous historical capital shifts:

| Economic Transformation | Time Period | Estimated Capital Shift (Inflation Adjusted) | Impact on Global Economy |
|---|---|---|---|
| 1st Industrial Revolution | 1750-1850 | $ 10 Trillion | Mechanization, steam engines |
| 2nd Industrial Revolution | 1870-1914 | $20 Trillion | Electrification, mass production |
| Post WWII Rebuildings | 1945-1980 | $30 Trillion | Infrastructure, trade expansion |
| Digital Era & Internet Age | 1990-2020 | $40 Trillion | IT, Telecom |
| Energy Transition | 2020-2050 | $100+ Trillion | Decarbonization, electrification, new energies |

Energy transition is expected to involve more than one hundred trillion dollars in cumulative investments by 2050. According to estimates from the IEA and

BloombergNEF, annual clean energy investments must increase three times by the 2030s to meet global net-zero targets.

The petroleum industry is responsible for 42% of energy-related emissions, more than any other industry (McKinsey & Company, 2020). Oil companies contribute directly and indirectly, through extraction, refining, and burning of fossil fuels, with $CO_2$ and methane. Agriculture also emits large amounts of methane (from livestock), but it is not as carbon intensive as fossil fuel combustion.

In this sense, the performance of the petroleum industry is key to the energy transition. According to the IEA (International Energy Agency, 2023), for governments to deliver in full their national energy and climate pledges, where the temperature rise would be limited to 1.7˚C by 2050, oil and gas demand should be 45 percent below today's level. For the governments to successfully pursue a 1.5˚C trajectory, emissions from the global energy sector need to reach net zero by mid-century and oil and gas use should fall by 75%.

However, also according to the same IEA report, oil and gas producers account for only 1% of total clean energy investments globally, with more than 60% of this coming from just four companies (TotalEnergies, BP, Shell and Equinor). Therefore, currently the petroleum industry is a marginal force in the world's transition to a clean energy system.

The energy transition requires significant policy and market shifts. Traditional regulatory tools, such as command-and-control regulations, subsidies, and market-based instruments, often struggle to effectively support this transition due to their rigidity, slow adaptability, and limited scope.

That's the reason why we decided to study the relationship between energy transition and financing. Funding for projects that support environmental sustainability (green financing) has gained significant traction, but it still faces several limitations. In addition, it is becoming increasingly hard for the petroleum industry to secure financing due to growing concerns over climate change, sustainability, and corporate responsibility.

At the same time, the petroleum industry faces growing pressure to align with ESG principles while maintaining profitability. Investors, regulators, and consumers are demanding greater transparency, reduced carbon footprints, and ethical business practices, making ESG a critical factor in the industry's future.

This article adopts a narrative review methodology to explore and discuss the financing mechanisms of the petroleum industry within the context of the global energy transition. The literature review was conducted using well-established academic databases, including Google Scholar, JSTOR, and SSRN. Key search terms employed included combinations of 'petroleum industry finance', 'energy transition', 'ESG investing', 'green finance', 'carbon capture and storage', 'sustainability-linked finance', 'reputational regulation', and 'sovereign wealth funds'. The selection of articles and studies was guided by criteria focused on recent and relevant scholarly contributions, with priority given to peer-reviewed articles published in the last decade to ensure currency and relevance to contemporary discussions. In

addition to academic journal articles, reputable industry reports and policy documents from recognized international institutions, such as the International Energy Agency (IEA), BloombergNEF, OECD, and the World Bank, were included to provide practical insights and validate theoretical findings. The synthesis of this literature aimed to comprehensively address financial structures and tools that support sustainability goals within the petroleum sector, critically evaluating their effectiveness and potential to foster alignment with global decarbonization efforts.

Section 2 talks about the importance of the petroleum industry to the energy transition. Section 3 explains the traditional forms of financing for the petroleum industry, both in terms of equity and debt. Section 4 talks about financing tools for sustainability and Section 5 describes how the stock market is being affected by sustainability, particularly considering ESG, greenwashing and minority shareholder activism. Section 6 discusses the forms of government financing to clean energy projects. Section 7 talks about NOCs and their role in financing energy transition. Section 8 describes potential new forms of financing to align the petroleum industry behavior to the energy transition. Finally, in Section 9, this article concludes that financing instruments connected to the petroleum industry are crucial to stimulate the required sustainability goals and that new financing structures may be useful to better align the interest of the petroleum industry to the energy transition goals.

## 2. Petroleum Industry and Energy Transition

The energy transition, including the shift from fossil fuel-based energy systems to low-carbon and renewable alternatives, is central to combating climate change and ensuring long-term energy security. While the petroleum industry is a major source of greenhouse gas emissions, it holds significant potential to facilitate the transition.

First of all, an increasing part of the petroleum industry investments have been dedicated to natural gas. Natural gas is often referred to as a 'transition fuel', a bridge between high-carbon fossil fuels like coal and oil, and zero-carbon energy sources such as wind, solar, and nuclear. Its relatively lower carbon intensity and compatibility with existing infrastructure have made it a key component in many countries' energy strategies.

One of the primary arguments for using natural gas as a transition fuel lies in its lower carbon dioxide emissions relative to coal and oil. When burned for electricity, natural gas emits approximately 50% - 60% less $CO_2$ than coal and 30% less than oil per unit of energy produced (U.S. Environmental Protection Agency, 2022). This makes it a more climate-friendly option, especially for countries heavily reliant on coal-fired power plants.

Natural gas-fired power plants offer operational flexibility, allowing them to quickly ramp up or down in response to fluctuations in energy demand or intermittent renewable generation. This makes them a valuable complement to wind and solar power, which are variable by nature. By serving as a backup source of

electricity, natural gas supports grid stability and energy security, particularly during periods when renewable sources are unavailable. This role is especially important in regions where energy storage technologies, such as batteries, are not yet widespread or affordable.

In fact, the past two years have seen a significant rise in global investments across the natural gas value chain, rebounding from a period of underinvestment. Stimulated by the 2022 energy crisis and surging natural gas prices, many nations and companies have funneled capital into natural gas projects for energy security and economic growth.

Additionally, major consuming countries like China and India set targets to expand gas in their energy mix, prompting state companies to pour capital into domestic gas fields, liquified natural gas (LNG) terminals, and city gas distribution. Moreover, specific policies have encouraged gas investment considering its value to the energy transition goals.

Australia, for example, has taken significant steps to integrate natural gas into its energy strategy. The Coalition government announced plans to classify gas as a critical mineral, granting gas producers access to a $4 billion export finance fund originally intended for net-zero emission initiatives. This policy underscores the government's commitment to supporting gas projects, recognizing their role in the national economy and the transition to cleaner energy sources (COX, 2025).

Apart from the natural gas, the petroleum industry is far from being a mere obstacle to energy transition, as generally perceived by the population, and should be considered as an enabler, contributing technical expertise, capital, infrastructure, and global reach to clean energy development.

One of the most valuable assets the petroleum industry brings to the energy transition is its technical know-how. Oil and gas companies have decades of experience in geoscience, complex project execution, and deep subsurface exploration. The same skills used to identify and manage oil reservoirs can be redirected toward identifying suitable $CO_2$ storage sites or extracting geothermal heat from deep rock formations (International Energy Agency, 2023).

The processes used in carbon capture and storage (CCS), identifying suitable geologic formations, drilling wells, injecting gases, and monitoring reservoirs, are nearly identical to those used in oil and gas extraction and enhanced oil recovery (EOR).

Oil companies bring advanced engineering and project management skills necessary to build and operate CCS systems. CCS requires complex infrastructure projects, such as capture facilities at industrial sites and long-distance $CO_2$ pipelines, and oil majors are accustomed to managing large-scale projects and integrating complex systems across multiple stakeholders.

The petroleum industry's involvement in CCS is not only beneficial, it is essential. Without its technical capabilities, infrastructure, and financial backing, it would be extremely difficult to scale CCS fast enough to meet global climate goals. The IEA notes that over 90% of current CCS capacity globally involves oil and gas

companies (International Energy Agency, 2023).

Another prime example is the development of offshore wind and floating wind turbines. Oil majors like Equinor and TotalEnergies have leveraged their offshore drilling expertise to construct floating wind platforms that operate in deep waters previously inaccessible to traditional wind farms. This transfer of knowledge and infrastructure from fossil fuel to renewable sectors exemplifies how the petroleum industry can accelerate clean energy deployment (Global Data, 2023).

In fact, one area that petroleum industry is uniquely positioned to assist the energy transition is infrastructure. Oil and gas pipelines, storage facilities, and port terminals can often be repurposed for use in transporting hydrogen or sequestering carbon dioxide.

Existing oil and gas infrastructure can be repurposed for $CO_2$ transport and storage. Pipelines used for natural gas or crude oil can be modified to carry $CO_2$, wells and storage reservoirs, especially depleted oil and gas fields, are ideal for $CO_2$ sequestration, oil fields already used for EOR can be transitioned to pure $CO_2$ storage operations, reducing development time and cost. This reuse of existing infrastructure significantly reduces the cost and time associated with scaling up new energy systems.

According to a study by Gas Infrastructure Europe, up to 80% of Europe's existing natural gas pipeline network could be retrofitted to carry hydrogen, saving billions in capital expenditures (Gas Infrastructure Europe, 2021). In Asia, China's National Offshore Oil Corporation (CNOOC) recently repurposed an offshore oil platform into a CCS site, demonstrating how oil infrastructure can be directly reused for carbon mitigation (Xinhua, 2023). These examples highlight the value of integrating existing petroleum industry assets into the clean energy future.

In fact, many oil and gas companies are investing in blue hydrogen (produced from natural gas with CCS) and green hydrogen (produced from water using renewable electricity). For instance, Sinopec in China recently launched a green hydrogen project powered by a 200 MW solar farm, aiming to produce over 20,000 tons of hydrogen per year (Sinopec, 2023). Similarly, Aramco shipped the world's first cargo of blue ammonia—a hydrogen derivative—from Saudi Arabia to Japan, indicating growing global trade potential (Ammonia Energy Association, 2025).

Geothermal energy, a reliable and emission-free energy source, has long been underutilized due to technological and economic barriers and it is another example of the petroleum industry influence over energy transition. Recent advancements, many of which borrow from oil drilling technologies, are opening new possibilities to this industry. Techniques like horizontal drilling and well stimulation, developed during the shale revolution, are now being applied to access deeper and more widespread geothermal resources.

Oil companies such as Chevron and BP have begun investing in geothermal startups and pilot projects. For example, Chevron has partnered with Eavor Technologies, a Canadian company developing closed-loop geothermal systems (Garza, 2023). In Indonesia, the state-owned oil company Pertamina operates nu-

merous geothermal plants and is expanding its portfolio through international partnerships. This growing engagement suggests that geothermal energy could become a significant area of convergence between traditional oil operations and the clean energy sector.

The importance of the petroleum industry in the energy transition cannot be reduced. While the sector has historically been associated with carbon-intensive operations, it now holds the tools to drive decarbonization across multiple fronts. From technical expertise in drilling and geology to infrastructure, capital, and global influence, oil companies have much to offer. Their active engagement in renewable energy, carbon capture, hydrogen production, and geothermal development can significantly accelerate progress toward a low-carbon future.

Despite the petroleum industry's capabilities, several challenges remain. As of 2022, clean energy investments made up only 2% - 3% of total capital expenditure among oil majors (International Energy Agency, 2023). For the petroleum industry to truly support the energy transition, a strategic shift is necessary, one that aligns its business model with long-term climate objectives. Governments and international institutions can help by setting clear policies, carbon pricing mechanisms, and subsidies for clean energy, including financing.

## 3. Financing the Petroleum Industry

The petroleum industry requires large-scale financing for exploration, drilling, refining, and infrastructure development. Traditional financing methods include debt, equity, and government support.

Debt financing is the process of raising capital by borrowing money from external sources, which must be repaid over time with interest. Forms of debt financing include direct loans, bonds, lines of credit, trade credit, commercial paper, lease financing and project financing.

On the debt side, major international and regional banks, hedge funds and private equity, provide direct loans to oil companies for drilling, pipeline construction, and infrastructure development. In direct loans, oil companies borrow a lump sum from lending institutions and repay it over time with interest, these loans may be secured (backed by collateral) or unsecured (no collateral). Unlike bonds or syndicated loans, direct loans come from a single lender or a small group of lenders and often have customized terms based on the borrower's financial health, project viability, and risk profile.

Oil companies also issue bonds to raise capital from investors to finance their operations, expansion, or projects, promising to pay periodic interest and return the principal at maturity. Companies with higher credit ratings can issue bonds at lower interest rates. Bonds may be secured (backed by assets) or unsecured (based on creditworthiness). Types of bonds used in oil financing include investment-grade bonds (for large, stable companies) or high-yield (junk) bonds (for smaller, riskier projects).

Large projects often require multiple banks to pool funds together for a certain

project on a project finance type of structure. Project finance is a specialized funding structure used to finance large-scale petroleum projects, such as oil and gas exploration, production, pipelines, refineries, and LNG facilities. This financing model is attractive because it limits the financial risk to the project's assets and cash flows, rather than relying on the sponsor's balance sheet.

In this structure, loans and investments are repaid from the project's future cash flows, rather than the general assets of the sponsoring company. Lenders have claims only on the project's assets and revenue, not the parent company's finances, and a separate legal entity is created to own and operate the project.

Besides major international and regional banks, multilateral development banks (MDBs), like the World Bank and African Development Bank, and export credit agencies (ECA), government-backed agencies, also provide capital through direct loans and project financing to the petroleum industry.

Reserve-based lending (RBL) is a form of financing specific to the oil and gas companies. RBL is a secured financing arrangement where lenders provide loans collateralized by the borrower's oil and gas reserves and other related equipment. This is a revolving credit facility (RCF) type of structure, allowing companies to borrow as needed. The loan size is determined by the estimated reserves rather than just corporate balance sheets and the debt is repaid by future cash flow generated from the company's production. Major commercial banks, specialized energy lenders and debt funds provide this kind of debt.

Apart from debt, the petroleum industry also commonly finances itself through equity. Equity financing is the process of raising capital by selling shares of ownership in a company. Instead of borrowing money (debt financing), businesses sell equity (stocks or shares or interest in assets) to investors in exchange for funds. These investors then become part-owners of the company and may receive returns through dividends or capital gains if the company's value increases or even participation in production.

Equity financing is ideal for businesses that need long-term capital for expansion, innovation, or restructuring. Unlike loans, companies do not need to repay equity financing. Since selling shares or interest in particular projects mean giving up partial ownership and, in some cases, decision-making power, investors take on the risk and expect returns through profits. Equity financing encompasses various types, including common stock, preferred stock, private equity, venture capital, angel investment, public offerings (both initial public offerings and follow-ons), crowdfunding, and joint ventures.

Equity financing through capital markets is particularly common for major oil and gas companies. Most fossil fuel reserves are controlled by publicly listed oil and gas companies and NOCs. NOCs are state-owned entities that perform the exploration, extraction, and sale of oil and gas resources inside or outside their countries.

While many NOCs remain entirely government-owned, a subset has chosen to list a portion of their shares on public stock exchanges. It is important to note that,

even in cases where NOCs are publicly listed, governments retain significant, if not majority, ownership stakes, maintaining substantial control over the companies' operations and strategic decisions.

Listed NOCs collectively control approximately 50% to 60% of the world's proven oil and gas reserves (World Economic Forum, 2022) and publicly listed oil and gas companies (including supermajors) with no state ownership control collectively around 10% - 15% of global oil and gas reserves. Therefore, it is possible to infer that listed NOCs together with publicly listed oil and gas companies (not related to the state) account for approximately 35 to 50% of the global oil reserves.

The listed NOCs and supermajors often raise capital from stock markets, while independent oil companies often do initial public offerings (IPOs) and get funded by private equities, such as Carlyle. Non-listed NOCs are directly funded and operated by the government, but companies in general (government backed or not) sell shares or assets to raise capital.

In an ESG economy, the petroleum industry faces significant challenges in securing financing due to growing concerns over climate change, sustainability, and corporate responsibility. Institutional investors, banks, and asset managers are shifting their portfolios toward sustainable and green investments. Many global funds and pension funds have policies restricting or excluding investments in fossil fuels.

One of the primary limitations stems from the growing regulatory and policy pressure to phase out fossil fuels. Governments and multilateral institutions have introduced stricter climate policies, including carbon pricing, emissions regulations, and public finance restrictions.

For instance, the European Union's Sustainable Finance Taxonomy discourages fossil fuel investments by excluding most oil and gas activities from its list of sustainable economic activities. This regulatory environment makes it more difficult for oil companies to access public funding or subsidies and increases compliance costs for new projects.

Institutional investors such as pension funds, sovereign wealth funds, and asset managers are divesting from fossil fuel assets or demanding clear net-zero strategies from oil companies. Financial institutions are pressured to align with frameworks like the TCFD and EU Taxonomy for Sustainable Finance, which discourage fossil fuel investments. Banks and financial institutions are increasingly refusing to fund new oil and gas exploration projects or not publicizing their connection to oil financing to avoid bad reputation.

ESG-focused lending results in higher interest rates and borrowing costs for oil and gas companies compared to renewable energy companies. Since companies in the petroleum sector are often seen as high-risk due to carbon emissions and environmental impact, they may, for example, struggle to issue bonds at competitive rates due to a shrinking pool of interested investors.

Another major concern is the risk of stranded assets. As global climate targets accelerate, long-term investments in oil and gas infrastructure may not yield ex-

pected returns, especially if demand declines faster than anticipated due to electrification or policy shifts. This leads lenders and investors to apply higher discount rates, demand shorter payback periods, or avoid certain types of fossil fuel investments altogether.

Additionally, the volatility of oil prices contributes to financial uncertainty. While short-term spikes may boost profits, long-term forecasts suggest a declining role for oil in the global energy mix. Coupled with growing legal challenges, reputational risks, and public pressure on banks and insurers, these factors create a cautious lending environment for the petroleum industry, making oil and gas companies less attractive to lenders and investors.

Despite being heavily reliant on fossil fuel sources of financing, some oil companies are tapping into green financing to support sustainability efforts. However, green bonds and sustainability-linked loans are designed for clean energy investments, limiting the financing options for petroleum companies.

Financing is more readily available for companies with strong decarbonization commitments rather than those maintaining traditional fossil fuel operations. While some petroleum companies seek financing for transition projects (e.g., carbon capture, biofuels, hydrogen), investors often demand clear, verifiable transition plans. Any ESG financing attempt by oil and gas companies is met with skepticism, with accusations of greenwashing (false sustainability claims).

## 4. Green Financing

Green financing refers to capital investments that support environmentally friendly projects, including renewable energy, energy efficiency, and climate adaptation. It is growing rapidly as banks, investors, and governments shift away from fossil fuels toward sustainable energy.

Green loans are a type of green financing specifically designed to fund environmentally friendly projects. They follow the Green Loan Principles (GLP) set by organizations like the Loan Market Association (LMA), Asia Pacific Loan Market Association (APLMA), and Loan Syndications and Trading Association (LSTA) to promote transparency, consistency, and credibility in green lending.

Borrowers must clearly define how the project contributes to environmental goals and funds must be tracked separately to ensure they are used exclusively for green projects. Regular updates are required to show how the loan is being used and its environmental impact.

Benefits of Green Loans include lower interest rates (in some cases) as an incentive for sustainability and enhancing corporate reputation by showing commitment to sustainability.

Green bonds are another form of green financing issued by governments, banks, and corporations. These are fixed income financial instruments used to raise capital for environmentally friendly projects. They work like regular bonds but with the condition that proceeds must be used for projects that benefit the environment.

Green bonds usually adhere to the Green Bond Principles (GBPs), established by the International Capital Market Association (ICMA), ensuring that the funds are directed towards green projects, such as renewable energy, clean transport, and climate projects. Issuers must regularly report on how the funds are used and their environmental impact, many green bonds undergo external review to ensure compliance with GBP.

Green bonds provide issuers with access to a growing market of ESG-conscious investors and, therefore, may offer lower borrowing costs due to strong investor demand, helping companies and governments meet climate and sustainability goals.

Sustainability-linked loans (SSLs) and bonds are also a form of green financing. They are direct loans or bonds linked to ESG performance with interest rate adjusting based on sustainability targets. If sustainability targets are met, borrower may get lower interest rates, if missed, penalties may apply. Therefore, it requires ongoing monitoring of ESG performance and regular reporting. Regulatory Standards are aligned with sustainability-linked loan principles (SLLP).

While green loans focus on financing specific environmentally friendly projects, sustainability-linked loans are broader, allowing funds to be used for general business purposes but requiring companies to meet sustainability-related targets. Both support sustainability, but in different ways, SLLs encourage overall ESG improvements and green loans directly fund eco-friendly initiatives.

Companies may also sell carbon credits to offset carbon emissions to finance themselves, either on regulated carbon markets or voluntary carbon markets. The carbon credit market is a system that allows companies, governments, and individuals to buy and sell carbon credits used to offset their GHG emissions. This market is designed to encourage businesses to reduce emissions and invest in sustainability.

A carbon credit represents one metric ton of $CO_2$ (or equivalent GHGs) removed or prevented from entering the atmosphere. There are two main types of carbon markets, the Compliance Carbon Market (Cap-and-Trade) and the Voluntary Carbon Market (VCM).

The Cap-and-Trade market is regulated by governments to control emissions from industries (e.g., power plants, manufacturing). Companies are assigned a carbon emissions limit (cap). If they emit less, they can sell their extra allowances. If they emit more, they must buy credits from others. Examples of Cap-and-Trade are EU Emissions Trading System (EU ETS) and California Cap-and-Trade Program.

In the VCM, companies and individuals voluntarily buy carbon credits to offset emissions. Credits are generated from carbon offset projects such as reforestation, renewable energy, or methane capture. Example: A company purchases credits from a forest conservation project to claim carbon neutrality.

Projects that reduce or remove $CO_2$ can generate carbon credits through certification by recognized bodies. However, not all carbon credits are of equal quality; some may not deliver real emission reductions. In addition, if credits are not properly tracked, multiple buyers may claim the same carbon reduction.

Certification bodies ensure that carbon credits are legitimate, verifiable, and contribute to real emissions reductions. They set standards, verify projects, and issue certified carbon credits. The certification bodies named Verra-Verified Carbon Standard (VCS) and Gold Standard (GS) dominate the voluntary carbon market. Climate Action Reserve (CAR) and American Carbon Registry (ACR) are widely used in North America. Plan Vivo focuses on community-driven carbon credit projects. Global Carbon Council (GCC) is the first carbon credit agency from the Middle East and the Clean Development Mechanism (CDM) was created by the United Nations to issue Certified Emission Reductions for compliance markets.

The carbon credit market is a key tool in global climate action, but it must be properly regulated to drive genuine emission reductions, ensuring transparency and quality.

The petroleum industry is at a crossroads with green financing, facing increasing pressure to transition toward sustainable energy investments. While still relying on traditional fossil fuel funding, some oil and gas companies are adopting green finance mechanisms to fund lower-carbon projects or small-scale sustainability projects, considering pressure from investors and regulators.

## 5. Stock Market and Sustainability

Investors, companies, and governments recognize the importance of ESG factors to the stock market. John Elkington was a pioneer in the ESG discussions, bringing the concept of the Triple Bottom Line (TBL), a framework that integrates People, Planet, and Profit into corporate performance evaluation. TBL measures corporate success beyond financial performance, emphasizing:

1) People (social impact)—Employee well-being, diversity, community engagement;

2) Planet (environmental impact)—Carbon footprint, sustainability, climate responsibility;

3) Profit (economic impact)—Ethical revenue generation, long-term financial resilience.

In the book 'The Coming Boom in Regenerative Capitalism", Elkington introduced the concept of 'Green Swans', referring to businesses that drive exponential positive change. The TBL framework has driven green finance innovations, such as sustainable bonds, ESG exchange-traded funds (ETFs) and carbon credits, and became the basis for ESG ratings, sustainability indices and impact investing.

The term ESG was officially introduced in 2004 in a United Nations report titled 'Who Cares Wins'. This report, led by UN Global Compact and major financial institutions, argued that ESG factors could enhance long-term financial performance. ESG integrates three key factors into investment decisions:

1) Environmental (E)—Climate change policies, carbon footprint, water usage, and renewable energy adoption;

2) Social (S)—Labor rights, diversity & inclusion, human rights, community

engagement;

3) Governance (G)—Board diversity, executive compensation, shareholder rights, ethical business practices.

Some studies suggest that companies with strong ESG practices often outperform in the long run due to lower risk and better governance. A comprehensive meta-analysis made by New York University Stern, reviewing over 1000 studies from 2015 to 2020, found that approximately 58% reported a positive relationship between ESG and financial performance, 21% showed neutral results, and 14% indicated a negative correlation (Whelan et al., 2021).

Recent research highlighted by the UN Principles for Responsible Investment (UN PRI), however, suggests that the volatile market environment of the last two years has stress-tested the relationship between returns and ESG factors. While the broad conclusions about relationships between ESG attributes and corporate performance remain valid, researchers are looking more closely at what we mean by ESG investing and ESG scores and assessments.

Still according to PRI, any links between ESG and performance are nuanced and complicated. As the industry papers (Müller et al., 2023; Ward & Gimber, 2024) note, correlations are influenced and complicated by issues such as: geography, market capitalisation, industry sector, relative and absolute rankings, ranking methodology changes, incomplete coverage of the investment universe, historical data limitations, varying government policies and incentives that impact company performance and shifting consumer behaviours.

Contrastingly, an analysis reported by The Times in 2024 revealed that UK green or sustainable funds underperformed market trackers over a five-year period, with investors experiencing significant losses compared to traditional funds. This underperformance was attributed to factors such as rising interest rates and concerns over greenwashing (English, 2025).

Larry Fink, the CEO of BlackRock, a prominent advocate for integrating ESG considerations into corporate strategies and investment decisions, emphasized, in his 2018 annual letter to CEOs, the importance of companies contributing positively to society alongside achieving financial performance.

However, in recent years, Fink's perspective on ESG has evolved, influenced by political and market dynamic, and has repeatedly stressed that ESG is not just about values, it's about economic value. Fink shifted his thinking on ESG towards 'financial materiality' rather than ideological positioning and expecting companies to focus on risk-adjusted returns and corporate disclosures rather than activism.

The traditional ESG framework has become central to how investors, regulators, and corporations evaluate sustainability performance. However, recent discourse has introduced the concept of EESG (Economic, Environmental, Social, and Governance) as a more comprehensive framework that explicitly incorporates economic sustainability alongside traditional ESG dimensions. EESG recognizes that long-term environmental and social goals cannot be achieved without robust economic foundations.

While ESG is often framed around non-financial indicators, there is a growing recognition that economic factors must be integrated into ESG assessments to ensure long-term sustainability, effectiveness, and stakeholder value. Without considering the economic implications of ESG actions, companies may struggle to align ethical ambitions with operational realities.

First, ESG initiatives must be financially sustainable to be impactful and scalable. As Khan, Serafeim, and Yoon argue in their study published in The Accounting Review (Khan, Serafeim, & Yoon, 2016), companies that focus on financially material ESG issues significantly outperform their peers in terms of stock returns and profitability. Their research underscores the importance of prioritizing ESG actions that are aligned with a firm's core economic risks and opportunities. Economic analysis, such as return on investment (ROI), cost-efficiency, and capital allocation, can help determine the viability of ESG initiatives and prevent greenwashing or ineffective spending (Khan, Serafeim, & Yoon, 2016).

Second, considering economic factors allows companies to adopt a materiality-based approach to ESG. The Sustainability Accounting Standards Board (SASB) and the Global Reporting Initiative (GRI) both emphasize that ESG reporting should focus on financially material issues, which are those likely to affect a company's financial condition or operating performance.

By integrating economic reasoning, companies can better identify which ESG risks or opportunities are most relevant to their sector and geography (Eccles & Klimenko, 2019). This not only improves decision-making but also meets growing investor demand for credible, outcome-oriented ESG metrics.

Furthermore, economic resilience and equity are essential to the 'social' dimension of ESG. The transition to a green economy must consider job creation, regional development, and supply chain security.

The concept of a 'just transition', advocated by the International Labour Organization (ILO) and endorsed in the Paris Agreement, emphasizes the need to balance environmental goals with economic justice for workers and communities. Without economic planning, ESG initiatives risk triggering unintended social consequences, such as energy poverty or labor displacement (Heffron & McCauley, 2018).

In fact, without some type of criteria or metric that guide the ESG discussion it is difficult to measure its results to the society or the companies involved. This is the origin of greenwashing. The term 'greenwashing' was first used in 1986 by environmentalist Jay Westerveld. He criticized hotels that encouraged guests to reuse towels to 'save the environment' while these same hotels made no real efforts to reduce waste or adopt sustainable practices.

Greenwashing refers to a deceptive marketing practice where a company exaggerates or falsely claims to be environmentally friendly to attract eco-conscious consumers. Instead of making real sustainability efforts, businesses use misleading advertisements, vague claims, or selective disclosure to create a false impression of being environmentally responsible.

The first notorious case of greenwashing was the Chevron's 'People Do' campaign launched in the 1980s. The campaign aimed to portray Chevron as an environmentally responsible company, although the company was facing multiple lawsuits, fines, and regulatory actions for pollution and environmental harm.

Chevron's 'People Do' campaign was one of the most effective greenwashing efforts in history, but it could not stop the company from facing legal consequences. Over the years, Chevron has paid millions in fines and settlements for pollution, oil spills, and environmental damage. This case sparked greater awareness and stricter ESG accountability standards in the decades that followed.

In recent years, several oil and gas companies have faced allegations and legal actions for greenwashing. In February 2023, advocacy group Global Witness filed a complaint against Shell with U.S. authorities, accusing the company of overstating its investments in renewable energy to mislead investors and the public (Buchsbaum, 2023).

In May 2023, environmental organizations Greenpeace Italy and ReCommon, along with twelve Italian citizens, filed a lawsuit against energy giant Eni. The plaintiffs accused Eni of contributing significantly to climate change through its continued investment in fossil fuels, despite being aware of the associated risks for decades. This case marked the first climate litigation against a privately owned company in Italy (*Greenpeace V. Eni*).

In mid-2024, TotalEnergies faced a ruling by South Africa's Advertising Regulatory Board (ARB), which found the company's campaign claiming a commitment to 'sustainable development' to be misleading. The case, brought forward by the non-profit group Fossil Free South Africa, argued that TotalEnergies' core business operations contradicted its sustainability claims. The ARB's decision highlighted the discrepancy between the company's advertising and its ongoing fossil fuel activities. This landmark decision underscored the increasing scrutiny of environmental claims made by oil and gas companies (Smyth & Rose, 2024).

These cases illustrate a growing global trend of holding oil and gas companies accountable for misleading environmental claims, emphasizing the need for transparency and genuine commitment to sustainability in corporate practices. Greenwashing has prompted regulatory bodies worldwide to implement measures ensuring transparency and accountability.

The European Union, for example, adopted, in January 2024, the Green Claims Directive. This directive mandates that companies substantiate environmental claims with scientific evidence. Terms like 'eco-friendly' or 'climate-neutral' must be backed by verifiable data to prevent deceptive marketing (O'Riordan, 2024).

The United Kingdom introduced, in May 2024, the Financial Conduct Authority (FCA) Anti-Greenwashing Rule. This rule requires financial products and services to accurately describe their sustainability features, ensuring that consumers are not misled by exaggerated claims. In addition, the Green Claims Code was developed by the Competition and Markets Authority. This code provides guidelines to prevent misleading environmental claims, promoting transparency and

consumer trust.

Finally, another aspect of the relationship between stock market and sustainability is minority shareholders activism. Minority shareholder activism refers to efforts by investors who hold a small (non-controlling) stake in a company to influence corporate governance, management decisions, or strategic direction. While they may lack majority control, minority shareholders can leverage legal rights, public pressure, and regulatory mechanisms to push for changes.

Tactics used by minority shareholders activism include: i) filing proposals and voting on key corporate issues at annual general meetings (AGMs); ii) suing for breaches of fiduciary duty or seeking intervention from financial regulators; iii) uniting with other minority shareholders or institutional investors to strengthen their influence; iv) using media, social networks, and activist funds to draw attention to corporate mismanagement; v) using media, social networks, and activist funds to draw attention to corporate mismanagement; and vi) persuading pension funds, mutual funds, or other large investors to support their cause.

Minority shareholder activism in the petroleum industry has led to significant corporate changes, particularly concerning ESG. For example, in 2021, Engine No. 1, a small activist hedge fund, acquired a modest stake in ExxonMobil and launched a campaign to address the company's inadequate response to climate change. Despite holding only about 0.02% of Exxon's shares, Engine No. 1 nominated four independent directors with energy experience to the board. The fund argued that Exxon's focus on fossil fuels posed existential risks and that a shift toward sustainable energy was necessary for long-term profitability. Gaining support from major institutional investors, including BlackRock, Vanguard, and State Street, Engine No. 1 succeeded in electing three of its nominees to Exxon's board.

Elliot Management and BP is an interesting case that shows the other side. In early 2025, Elliott Management, a prominent activist hedge fund, acquired nearly a 5% stake in BP, aiming to influence the company's strategic direction. BP had been transitioning from traditional oil and gas operations to renewable energy investments. However, underperformance in its share price and strategic ambiguities led Elliott to advocate for a reassessment of BP's approach. Potential changes proposed included focusing more on core oil and gas businesses, considering a U.S. stock market listing, or even breaking up the company. This move underscored the ongoing tension between pursuing green energy initiatives and maintaining profitability in the oil and gas sector.

In fact, minority ESG activists often face challenges, such as that companies may refuse to engage or dilute activist efforts, legal frameworks may limit minority shareholder power, large passive investors (e.g., Vanguard, BlackRock) sometimes side with management rather than activists, and some shareholders prioritize short-term financial gains over sustainability.

In a recent regulatory development on minority shareholder activism, SEC revised its Guidelines on Shareholder Proposals and introduced new rules making it more challenging for shareholders to propose ESG-related resolutions. These

changes empower corporate boards to block initiatives targeting climate policy and workforce diversity more easily.

Even before that, support for ESG-related shareholder proposals reached a record low in 2024, with only 1.4% of 279 resolutions receiving majority backing. This decline is largely attributed to reduced support from major U.S. asset managers amid political pressures and poor economic results (Markotoff, 2025).

## 6. Government Financing and Sustainability

Government financing plays a pivotal role in advancing sustainability initiatives by providing essential funding, incentives, and policy support. These efforts in various forms aim to promote sustainable development, address climate change, and foster responsible business practices.

To successfully finance the energy transition, governments use a mix of policy instruments and financing models to mobilize capital, reduce risk, and encourage investment in clean energy. Policy instruments, for example, include Carbon Pricing Mechanisms, which makes fossil fuels more expensive and clean energy more competitive. Direct taxes on carbon emissions have been used in countries like Sweden and Canada.

Policy instruments also include Emissions Trading Systems (ETS), which is a cap-and-trade system where companies buy and sell emission allowances. The European Union Emissions Trading Scheme generates billions in revenue, part of which is reinvested into green projects through the Innovation Fund.

Renewable Energy Mandates and Auctions are also another form of energy transition policy. In this case, governments mandate energy suppliers to generate a specific share of their power from renewable sources. Feed-in Tariffs (FiTs) used in Germany is one example, through this policy revenue is guaranteed for renewable energy producers. Renewable Energy Auctions is another example, where competitive biddings are organized to secure contracts for clean energy projects at the lowest price in countries such as Brazil and India.

Tax Incentives and Subsidies to clean energy are also policies often used by different countries. Investment Tax Credits (ITC) are tax reductions for companies investing in clean energy, U.S. Inflation Reduction Act is an example. Production Tax Credits (PTC), which are direct incentives per unit of clean energy produced, are also common in certain countries. Moreover, depreciation benefits are also used, allowing accelerated depreciation for renewable energy assets.

Financing models for energy transition include, for example, sovereign green bonds, which are government-issued bonds for renewable energy projects. Brazil, for example, uses its ESG bond program to fund Amazon rainforest preservation, allocating proceeds to environmental and social projects without creating dedicated sovereign debt. France issued one of the largest sovereign green bonds—€82.2 billion, as disclosed in 2025 (La Republique Française, 2025)—to finance low-carbon transport, energy efficiency, and biodiversity protection. The Chinese government has issued over $200 billion in green bonds to support renewable en-

ergy, green buildings, and pollution control (Tang et al, 2023).

Governments also collaborate with private investors through public-private partnerships (PPP) to finance energy transition projects. Build-Operate-Transfer (BOT) model is one example, where private companies develop energy infrastructure, operate it for a period, and later transfer ownership to the government. Governments also grant private entities rights, through concession agreements, to operate energy projects under certain conditions. The Morocco's Noor Solar Complex is an example of a PPP project financed by public and private investors, including the World Bank.

Blended finance is another form of combining public and private funds to de-risk renewable energy investments. In first-loss capital, public funds absorb initial losses of clean energy projects to attract private investors. In concessional loans, low-interest loans are provided from development banks to finance energy transition projects.

Governments have been also establishing National Climate Funds, which are dedicated funds for renewable energy projects. The Kenya's Renewable Energy Fund, aiming to support small-scale solar and wind projects, is one example. The Clean Energy Finance Corporation (CEFC), an Australian government-owned green bank investing in clean energy projects to help achieve net-zero emissions by 2050, is another example. CEFC supports initiatives in renewable energy, energy efficiency, and low-emission technologies.

Finally, Multilateral Climate Funds have also been created to provide financing for large-scale clean energy transitions, such as the Green Climate Fund, established by the UNFCCC. The Global Environment Facility (GEF) is another multilateral environmental fund providing grants and blended finance for projects related to biodiversity, climate change, and sustainable cities in developing countries. GEF serves as a financial mechanism for several international environmental conventions.

In addition to direct government initiatives, SOEs are a vehicle for energy transition financing. SOEs play a significant role in the global economy, particularly in strategic sectors such as energy, transportation, mining, and infrastructure. As public institutions that operate under government ownership or control, SOEs have both economic and social mandates, often balancing profitability with public interest.

In the era of climate change and environmental degradation, the role of SOEs in advancing sustainability has come under increasing scrutiny. Their size, influence, and policy alignment position them as key actors in achieving national and global sustainability goals.

SOEs are uniquely positioned to lead sustainable development initiatives, especially in countries where they dominate resource-intensive industries. They have the institutional capacity, policy alignment, and access to public finance needed to implement large-scale green projects. For example, energy SOEs in countries like China, Norway, and Saudi Arabia have invested in renewable energy, energy

efficiency, and low-carbon technologies, often driven by national climate targets and green industrial policies.

In developing countries, SOEs can also play a critical role in supporting a just transition by providing access to affordable and clean energy, investing in green infrastructure, and ensuring economic stability for workers and communities affected by decarbonization.

As public entities, SOEs have a higher accountability to citizens and governments than private firms. This implies a responsibility to operate transparently and to internalize social and environmental costs, rather than externalize them.

According to the OECD, SOEs should lead by example in corporate governance and sustainability reporting, especially since many operate in high-emission sectors (OECD, 2020a). Their actions can set standards for the broader market, influence private sector behavior, and contribute to national climate and development commitments such as the Paris Agreement and the UN Sustainable Development Goals (UN SDGs).

Fossil Fuel Subsidy Reforms are also policies often used to foster energy transition, redirecting subsidies from fossil fuels to clean energy projects. While originally intended to promote energy access, affordability, and industrial development, these fossil fuel subsidies have increasingly come under criticism for distorting markets, burdening public budgets, and undermining climate goals. According to the International Monetary Fund (IMF), global fossil fuel subsidies—including both explicit and implicit forms—reached an estimated $7 trillion in 2022 (IMF, 2023).

Fossil fuel subsidies can be categorized into three main types:

1) Consumer subsidies: Government support that lowers fuel prices below market levels through price controls, direct payments, or tax exemptions;

2) Producer subsidies: Incentives that lower the cost of fossil fuel production, such as exploration tax credits, reduced royalties, or investment support;

3) Implicit subsidies: The failure to internalize externalities such as climate change, local air pollution, and road congestion in fossil fuel pricing.

Despite their drawbacks, fossil fuel subsidies persist due to several compelling arguments, including that it helps maintaining low fuel prices, which is essential in developing countries, and that it serves as a mechanism to prevent unrest due to fuel price volatility, as seen in Iran (2019) and Ecuador (2019).

In fact, subsidies reduce energy costs for key industries, including transportation and agriculture, supporting domestic production and exports. They are seen as tools for industrial policy and economic stimulus. Some argue that fossil fuels are still needed to support basic energy infrastructure during development phases.

Critics of fossil fuel subsidies highlight their negative economic, environmental, and social consequences, arguing that they undermine carbon pricing and climate goals under the Paris Agreement, artificially lowering prices for fossil fuels, distorting energy markets and discouraging investment in renewables and efficiency.

Continued fossil fuel subsidies send conflicting signals to investors and under-

mine credibility in international climate forums. Many countries have pledged to phase out inefficient fossil fuel subsidies (G20, APEC) but implementation remains slow. However, subsidies are politically popular, especially where energy is seen as a public entitlement, reform is difficult without viable alternatives or compensation mechanisms.

Some interesting examples are:

1) India: phased out kerosene and LPG subsidies, using Aadhaar-linked transfers;

2) Indonesia: reduced fuel subsidies and introduced cash compensation for the poor; and

3) Iran: introduced direct cash transfers to cushion the impact of fuel price hikes.

Therefore, fossil fuel subsidies represent a critical intersection between energy policy, fiscal governance, and climate strategy. While they offer short-term political and economic advantages, their long-term costs—environmental degradation, fiscal inefficiency, and inequity—are increasingly unsustainable. Global experience suggests that reform is both feasible and beneficial if designed with care, transparency, and robust social support mechanisms. Reallocating subsidies toward clean energy, public health, and targeted welfare can help governments build resilient, inclusive, and sustainable energy systems.

## 7. The Role of NOCs

The NOCs are an important part of the SOEs involved in energy transition. Representing over half of the world's oil and gas production and controlling most of the proven reserves, NOCs are central to both the fossil fuel economy and the global push toward sustainability.

Unlike international oil companies (IOCs), which are accountable to private shareholders, NOCs operate under government ownership and often serve national policy goals, ranging from energy security to public revenue generation. This dual mandate presents both an opportunity and a challenge for sustainable development.

For many NOCs, aligning with sustainability goals is constrained by structural and economic barriers. Most are embedded in economies that depend heavily on hydrocarbon revenues, making rapid diversification politically and fiscally challenging. Additionally, many NOCs lack transparency, report limited environmental metrics and invest far less in clean energy compared to their private-sector counterparts. According to the IEA, few NOCs have committed to long-term climate targets or adopted emissions-reduction strategies at scale (International Energy Agency, 2023).

Despite these challenges, some NOCs are beginning to engage with sustainability in meaningful ways. Companies like Equinor (Norway), PETRONAS (Malaysia), and ADNOC (United Arab Emirates) have set net-zero targets and are investing in low-carbon technologies such as hydrogen, CCS, and bioenergy. In Saudi Arabia, Aramco has expanded its focus to include cleaner fuels and carbon

management as part of the country's Vision 2030 strategy. These developments reflect a growing awareness that NOCs must adapt to shifting global energy markets and environmental expectations.

For NOCs to contribute meaningfully to sustainability, reforms in governance and performance accountability are essential. According to the OECD (OECD, 2015), NOCs should be held to high standards of transparency, with climate and ESG metrics integrated into performance evaluations. Governments must also reorient national energy strategies to align with net-zero targets, encourage NOC investments in renewable energy and clean fuels, and reduce dependence on fossil fuel revenues over time (World Bank, 2020).

NOCs are essential to the energy transition, while they have been slower than private firms to embrace sustainability, their scale, influence, and government backing position them to lead if the right governance, incentives, and policies are in place. Without their active participation, the global shift to a low-carbon future will be slower, riskier, and more uneven.

NOCs are increasingly turning to green and sustainable finance instruments to raise capital for transition projects. One notable trend is the issuance of green bonds and sustainability-linked sukuk by NOCs or their subsidiaries. Aramco, for example, has begun to engage in sustainable finance market, raising billions of dollars to fund projects aligned with a low-carbon energy future through green bonds and sukuk. While Aramco is cash-rich, these issuances (along with sustainability-linked loans) signal to investors that capital is being earmarked for ESG objectives and help benchmark the cost of capital for Aramco's climate initiatives.

In Southeast Asia, Petronas pioneered an Islamic sustainability bond: in 2021 it issued a multi-billion-ringgit sustainability sukuk, reportedly one of the largest in the region, to finance renewable energy and emissions reduction projects (e.g. solar farms and energy efficiency upgrades). Petronas was also recognized for a $527 million sustainability-linked loan in 2023 tied to decarbonization targets, reflecting how NOCs can leverage loan terms to incentivize meeting climate goals.

Chinese NOCs have tapped domestic bond markets with government-blessed 'carbon-neutral bonds.' Sinopec, for instance, was among seven Chinese state-owned energy companies that issued such bonds, with proceeds totaling ¥18.2 billion (~$2.8 billion) in one year (Xu, 2021). These bonds fund projects like solar-powered hydrogen production and $CO_2$ capture. Sinopec's own issuance helped finance its Kuqa green hydrogen plant in Xinjiang, which came online in 2023 as China's largest solar-to-hydrogen facility.

In the Middle East, NOCs are beginning to follow suit: ADNOC in 2024 obtained its first 'green' funding, a $3 billion loan structured under green finance principles from Japan's JBIC and partner banks, and it has converted existing debt to sustainability-linked terms through subsidiaries (ADNOC Distribution turned a $1.5 billion term loan into a sustainability-linked loan) (Thompson, 2024).

These instruments open NOCs to a broader pool of ESG-minded investors and often come with reporting obligations on how proceeds are used, thereby increas-

ing transparency. The overall trend is that NOCs are slowly leveraging capital markets to share the funding burden of the energy transition. However, it's worth noting that only a subset of NOCs, typically those with stronger finances and partial market listings, have issued green bonds to date, while highly indebted NOCs (e.g. Pemex) have struggled to do so, instead relying on government support for any climate investments.

Multilateral development banks and international finance institutions are also playing a role, albeit a relatively small one so far, in financing NOCs' energy transition efforts. Institutions like the World Bank and regional development banks have historically been hesitant to fund state oil companies but are now identifying areas where support for NOCs can yield climate benefits (such as methane emissions reduction and flaring elimination).

According to analysis by Environmental Defense Fund and RMI, financing by multilateral development banks can catalyze action by NOCs, especially by providing technical aid and capital for methane mitigation projects (Environmental Defense Fund, 2025). For instance, the World Bank's Global Gas Flaring Reduction partnership has worked with NOCs in countries like Nigeria and Iraq, offering funding and expertise to install gas-capture equipment.

In 2022, Nigeria's National Petroleum Company secured a commitment from the African Export-Import Bank (Afreximbank) for $5 billion in financing to support its upstream investments and energy transition plans. Part of this facility is expected to fund new gas infrastructure and possibly solar projects to electrify Nigerian operations (Bracewell, 2023).

In a similar vein, the African Development Bank has provided loans for Sonangol (Angola's NOC) to install renewable power at Angolan oil facilities and to study green hydrogen opportunities.

These examples remain the exception rather than the norm, but they highlight an emerging pattern of 'climate-aligned' lending to NOCs. Such support is often conditioned on measurable emissions reductions or clean energy outputs, aligning with global climate finance goals. Going forward, expanded multilateral support could help bridge the funding gap for NOCs in developing countries that lack the capital to invest in decarbonization on their own.

A review of NOCs' financing activities reveals several clear patterns and regional differences. Gulf NOCs (e.g. Saudi Aramco, ADNOC, QatarEnergy) benefit from strong cash flow and state support, enabling them to commit sizable sums to new energy without jeopardizing core oil investments. These wealthy NOCs are issuing fewer green bonds (since they have ample internal funds) but are instead creating venture funds and forging high-profile alliances, effectively using oil revenues and sovereign wealth to seed the clean energy industries of the future. Their focus is often on low-carbon fuels (hydrogen, ammonia) and carbon capture to ensure continued relevance of hydrocarbon assets in a decarbonizing world.

Emerging-market NOCs like Petronas, Ecopetrol (Colombia), and Petrobras are under growing pressure (from governments and investors) to diversify, but

face budget constraints. They are taking a gradual approach: dedicating a modest portion of capex (approximately 5% - 10%) to renewables and pilot projects now, while relying on partnerships or project financing to expand these ventures. Mexico's Pemex, for example, has set emission-reduction goals (including net-zero by 2050) on paper but is investing almost nothing in renewables (ESG News, 2025). Its limited cash is absorbed by oil production and debt payments, and the government's support has gone toward shoring up Pemex's finances rather than green projects (Fitch Ratings, 2025).

A glaring gap is that many NOCs in developing countries lack access to affordable capital for clean energy, precisely where multilateral development banks could step in more assertively. The data show that while well-capitalized NOCs like ADNOC can support lower-capacity peers with funding, a broader framework is needed to finance transition efforts by NOCs with 'smaller pockets.' Indeed, experts warn that expecting a rapid or uniform pivot by NOCs is unrealistic if their core revenues are at risk.

## 8. New Oil and Gas Financing Instruments and Energy Transition

### 8.1. Global Investment Trends in Energy Transition

Global investments in clean energy have experienced significant growth in recent years, reflecting commitment to transitioning towards sustainable energy sources. These investments have accelerated since 2020, with spending on renewable power, grids, and storage exceeding total spending on oil, gas, and coal since 2023 (Statista, 2025).

In 2024, global energy investment surpassed $3 trillion, with $2 trillion directed towards clean energy technologies and infrastructure—including renewables, electric vehicles, nuclear power, grids, storage, low-emissions fuels, efficiency improvements and heat pumps—according to the latest edition of the IEA's annual World Energy Investment report (International Energy Agency, 2025). The remainder, around $1 trillion, went to coal, gas and oil.

Despite the record numbers, investment in the low-carbon energy transition grew only by 11 per cent in 2024, therefore, in a slower pace than in the previous three years when it grew on average 24 - 29 per cent per year.

Current spending levels are insufficient to meet global net-zero emissions targets by mid-century. Achieving these goals require an average annual investment of $5.6 trillion from 2025 to 2030. Present investment levels are only 37 per cent of what is required to get on track, according to BloombergNEF's energy annual investment trends (Bloomberg NEF, 2025).

Also, according to the BloombergNEF annual report, there is a growing split of capital attraction between energy sectors that are proven—with business models that are not dependent on cheap money or political support—against those that are not proven. In 2024, 90 per cent of all clean energy investment went into proven clean energy technologies, such as electric vehicles, renewable energy gen-

eration, energy storage and power grids.

Therefore, financing sources moved away from areas of higher risk, or that have yet to scale, such as carbon capture, hydrogen, electrified heat, as well as clean technologies for hard-to-abate sectors (i.e., for steel, cement or shipping). The question, then, becomes, how can we incentivize financing sources dedicated to not proven energy alternatives, in addition to fostering energy transition in general?

Despite trillions of dollars spent on renewable energy in recent years, hydrocarbons still account for over 80% of the world's primary energy, according to The Energy Institute (Energy Institute, 2025).

Subsidizing oil companies can lead to moral hazard, reducing their incentive to mitigate climate-related risks by insulating them from financial accountability. Additionally, such subsidies risk perpetuating carbon lock-in, delaying necessary shifts toward sustainable energy systems by reinforcing dependence on fossil fuel infrastructures and technologies (Seto et al., 2022)

The financial markets were already losing confidence in the energy transition before Donald Trump returned to the White House. Trump, in January 2025, signed an executive order to withdraw the United States, the world's second-largest producer of greenhouse gases, from the Paris Agreement.

Data shows that financial markets have been slowly disconnecting from the idea of drastic energy transition. In early 2025, the S&P Global Clean Energy Transition Index has been down around 65% from its peak in early 2021. Over the same period, the S&P World Energy Index, comprised of oil and gas producers, has nearly doubled (Chancellor, 2025).

### 8.2. Realistic Perspectives on Energy Transition

Addressing climate change is a collective action problem. The benefits from lower emissions are shared by the whole world, but the costs are borne by individual countries. Global deals like the 2015 Paris climate agreement were an attempt to solve this problem, however, we should consider that we need to be realistic on how to deal with energy transition.

According to Professor Vaclav Smil, we should not ignore the experience of the past grand energy transition (from traditional biomass energies to fossil fuels) and we should not underestimate the concatenation of challenges presented by practical engineering, material, organizational, social, political, and environmental requirements of the unfolding transition to a fossil carbon-free world.

In his reconstruction of global energy supply (including the traditional biomass energies), Vaclav shows that fossil fuels, and later also hydro and nuclear electricity, rose from just 2 percent in 1800 to 95 percent in 2020, in what he named as the first energy transition. Therefore, considering that, after more than two centuries, the first energy transition is still not complete, we should not expect the current energy transition to be completed so soon (SMIL, 2024).

In fact, nearly 3 billion people (in Africa, monsoonal Asia, and Latin America) still depend, mainly for cooking, some also for heating, on traditional biomass

energies: fuel wood (and charcoal made from it), straw, and dried dung still supplied about 5 percent of the world's primary energy in 2020.1 This shows how we have disparities between different countries or regions of the world and how the issue of energy cost is relevant for the future of energy.

Therefore, all sources of energy will play a growing role in meeting the rising energy demand for the foreseeable future and we should design an energy financial system that serves both clean energy (proven and unproven technologies) and conventional energy, considering the needs of developed and developing nations alike.

The financial sector is increasingly recognized as a crucial lever for accelerating the global energy transition. While much attention has been given to excluding oil and gas companies from sustainable finance, there is growing momentum around developing new financial products that incentivize these companies to transition their business models.

As Mazzucato and Semieniuk emphasize, financial mechanisms must actively shape innovation and corporate strategies toward societal goals like decarbonization, not merely reflect existing market structures (Mazzucato & Semieniuk, 2018). In this context, new instruments tailored to the petroleum industry could play a transformative role by embedding energy transition incentives directly into their financial structures.

The global energy transition requires significant capital investment not only in emerging clean technologies but also in reorienting traditional oil and gas companies. Rather than excluding fossil fuel companies from sustainable finance entirely, designing financial incentives that encourage these companies to shift their business models toward low-carbon energy can serve as powerful levers to promote this transformation, considering the importance of the petroleum industry to the energy transition, as described in Section 2.

One promising innovation is the concept of Transition-Linked Reserve-Based Lending (TL-RBL), also regarded as the bedrock for energy project finance. Traditionally, RBLs limit borrowing to the value of a company's oil and gas reserves. A transition-linked model would extend borrowing capacity by including clean energy assets, such as carbon capture facilities, renewable energy projects, or hydrogen infrastructure, into the reserve base (Thomson Reuters, 2025).

This would encourage companies to diversify their portfolios toward low-carbon activities. This idea resonates with the work of Goldthau and Sitter, who argue that new 'rules of the game' must guide market actors toward sustainability, blending traditional financial instruments with climate objectives (Goldthau & Sitter, 2020).

Another emerging possibility is Carbon Abatement Performance Bonds (CAP Bonds), where bond repayment conditions would be tied to verified emissions reductions rather than just project expenditures or commitments. This model

[1]Approximation based on the worldwide annual consumption of 1.9 billion cubic meters of fuelwood and on the assumption that at least 10 percent of crop residues are used for fuel.

would directly reward real-world climate outcomes.

The logic follows Sovacool's emphasis on shifting from promised sustainability to proven results in energy governance. Oil and gas companies would thus be financially incentivized to invest in genuine carbon abatement measures, with penalties for underperformance enhancing the credibility of the instrument (Sovacool et al., 2023).

Energy Transition Equity Instruments (ETEIs) could also gain traction. These convertible bonds or preferred shares would link conversion terms to clean energy milestones, such as installed renewable capacity or methane emissions reduction.

A similar logic underpins Brookfield's Global Transition Fund, which raised $15 billion to invest in decarbonizing high-emission sectors by embedding transition criteria into its equity investments (Brookfield Corporation, 2022). This approach highlights that financing instruments do not need to abandon traditional corporate finance tools but can recalibrate them to favor low-carbon behavior.

Beyond these innovations, Transition-Indexed Loans present a dynamic alternative to static sustainability-linked loans. Loan margins would adjust annually based on a composite transition score, incorporating metrics like the share of capital expenditure on renewables, emissions intensity reductions, and development of clean technologies.

Such adaptive structures would align with Altenburg and Pegels' suggestion that successful green transformations require ongoing, performance-based incentives rather than one-off signals (Altenburg & Pegels, 2012).

Meanwhile, Green Decommissioning Financing Facilities could support responsible retirement of aging oil and gas assets—a major but under-addressed aspect of decarbonization. Governments or multilateral banks could back these facilities, providing cheaper capital for dismantling infrastructure safely and sustainably. Recent moves by entities like the UK Infrastructure Bank to explore financing for offshore decommissioning hint at the viability of such specialized products.

Finally, government incentives and de-risking tools applicable to CCS, including robust carbon pricing mechanisms and long-term offtake agreements are essential for scaling this critical decarbonization technology. In addition, classifying CCS as a sustainable activity can unlock green bonds, SLLs and institutional capital.

These emerging models share a common thread: they shift financial rewards to performance in climate action. Yet they also depend critically on independent verification, strict KPI setting, and transparent reporting, key lessons highlighted by recent criticisms of greenwashing in oil and gas companies transition plans (Li, Trencher, & Asuka, 2022).

In sum, as explained, rather than merely excluding oil and gas companies from the financial market, a more effective strategy may involve creating financial products that make the energy transition profitable for them. As the global investment community increasingly seeks real climate impact alongside returns, such innovative instruments could become central to aligning financial flows with the goals

of the Paris Agreement, turning incumbent oil and gas companies from obstacles into active agents of transformation.

### 8.3. The Role of Oil and Gas Companies in Clean Energy Development

As discussed in Section 2, the petroleum industry has much to offer to the energy transition, including technical expertise in drilling and geology, infrastructure, capital, and global influence. Their active engagement in clean energy can significantly accelerate progress towards a low-carbon future.

In fact, while private investors are mostly focusing their energy transition efforts to proven energy technologies, the financing resources oil and gas companies mobilize—whether from their own balance sheets, state coffers, or external investors—is being channeled into a broad spectrum of transition-related projects, with renewables (power generation) and decarbonizing fuels (hydrogen, biofuels) featuring prominently alongside emission-reduction technologies like CCS and efficiency upgrades.

Sinopec, for example, is investing heavily to become a top hydrogen supplier. It opened a solar-powered electrolysis plant in 2023 (20,000 ton/year capacity) and is building at least 1000 hydrogen refueling stations by 2025, supported by internal funds and state-backed green bonds.

ADNOC and Aramco are each pursuing blue hydrogen/ammonia (hydrogen derived from natural gas with $CO_2$ capture) to monetize their gas reserves in a low-carbon way. Aramco plans up to 11 million tons of blue ammonia per year by 2030 for export, an effort it will finance through a mix of capital spending and partnerships with importing countries.

Carbon capture, utilization, and storage (CCUS) is receiving funding as well: Petronas and Petrobras have allocated budget to CCS hubs (often with IOC partners as noted), and Equinor's Northern Lights project (with heavy government subsidy) is paving the way for commercial $CO_2$ storage services in Europe.

Oil and gas companies are also putting money into clean fuels and electric mobility in niche ways. For example, Thailand's PTT (an NOC) set up an EV charging subsidiary and China's CNPC/Sinopec have installed EV charging networks at their nationwide fuel stations, funded by their downstream business units. Additionally, biofuels and petrochemical diversification form part of the strategy: Petrobras is revamping an existing refinery to produce renewable diesel and jet fuel, and Indonesia's Pertamina is co-processing palm oil with diesel in its refineries (with financial support from the Indonesian government) to meet biofuel mandates.

Moreover, since government funds often set the stage for substantial private sector involvement by demonstrating commitment and confidence in clean tech sectors, financing NOCs involvement in energy transition would not only amplify the impact of public funds into clean energy but also foster a collaborative environment favourable to large-scale adoption of sustainable technologies.

As major players controlling large shares of global oil and gas reserves, NOCs such as Saudi Aramco, Petrobras, and ADNOC wield significant market influence. By leveraging public and concessional financing to support NOCs' clean energy investments—such as carbon capture, green hydrogen, and renewable projects—governments and development banks would not only decarbonize critical assets but also send powerful market signals.

Ultimately, mobilizing NOCs through targeted financing could unlock a dual benefit: directly lowering emissions from some of the world's largest energy producers while catalyzing wider private sector engagement in the transition.

Finally, another critical avenue for financing and de-risking energy transition projects is forming partnerships between NOCs and international oil companies (IOCs) or other private companies. By pooling capital and expertise through joint ventures, NOCs can undertake larger or more complex low-carbon projects than they could alone and extend even more the reach of energy transition finance and influence.

For example, ADNOC has partnered with BP and Masdar to develop hydrogen and CCS projects—one high-profile JV plans to invest in blue hydrogen production in the UK (H2Teesside) as well as green hydrogen in the UAE, combining ADNOC's gas resources and BP's technology.

In Malaysia, Petronas and ExxonMobil signed agreements in 2023 to jointly develop CCS hubs for $CO_2$ from Southeast Asian industries. These partnerships will share project costs and could utilize Exxon's proprietary CCS technology with Petronas's regional infrastructure.

Brazil's Petrobras is collaborating with European energy companies on renewables: it has MOUs with Norway's Equinor and others to explore offshore wind farms off Brazil's coast, potentially co-investing in the first wind projects to power Petrobras' platforms and provide green electricity to the grid.

In the Middle East, Saudi Aramco has taken stakes in international firms specializing in clean energy (for instance, investing in a South Korean hydrogen carmaker and partnering with Japan's Tohoku University on ammonia fuel research and development).

These examples show how joint ventures allow NOCs to tap outside capital, often attract financing from export credit agencies or foreign banks backing the international partner and accelerate knowledge transfer.

### 8.4. Sovereign Wealth Funds and Energy Transition

In addition to NOCs, Sovereign wealth funds (SWFs) are also powerful financial entities that manage state-owned capital derived from oil and gas revenues. Initially designed for macroeconomic stabilization, intergenerational savings, and investment diversification, these funds are evolving into strategic actors in global capital markets. As the urgency of climate change accelerates, the involvement of SWFs, especially those created from hydrocarbon rents, in the energy transition is increasingly imperative.

The transformation of natural resource rents into diversified financial assets is economically grounded in theories such as Hotelling's Rule, which posits that the net price of an exhaustible resource should increase at the rate of interest, implying a need to convert finite resources into long-term capital (HOTELLING, 1931).

The rationale for SWFs also draws from the need to avoid Dutch disease, a phenomenon where resource booms lead to currency appreciation and the decline of other tradable sectors (Corden & Neary, 1982). By investing revenues abroad, SWFs can help maintain economic competitiveness and avoid overheating domestic economies. The resource curse thesis, linking abundant natural resources with weak institutional development, also underscores the importance of institutional mechanisms like SWFs to ensure good governance and long-term planning (Loss, 2018).

As long-term institutional investors, SWFs are exposed to climate-related financial risks, including stranded assets, carbon pricing, regulatory shifts, and physical climate impacts. According to the IEA (International Energy Agency, 2021) and NGFS, (NGFS, 2023) the delayed integration of climate risk into investment strategy increases both economic and financial costs. These risks challenge the fiduciary obligation of SWFs to preserve intergenerational wealth, necessitating strategic reallocations into sustainable sectors.

Given that many SWFs are funded by oil rents, investing in clean energy serves as an economic hedge against declining demand for hydrocarbons. Diversifying into renewables, sustainable infrastructure, and cleantech reduces systemic dependency on fossil fuel revenue and prepares portfolios for a low-carbon future.

As agents of the state, SWFs are expected to support national climate objectives. Where governments have pledged net-zero targets or signed international climate agreements, SWFs face normative pressure to align their portfolios accordingly. Institutions such as the OECD (OECD, 2020b) and World Bank (World Bank, 2023) have explicitly called on SWFs to contribute to the financing of the energy transition.

The OECD report emphasized the potential of SWFs to mobilize capital for climate objectives and highlighted governance reforms needed for greater impact. It recommended improved transparency, ESG integration, and partnerships with development finance institutions.

The World Bank suggested that SWFs should act not only as financiers but also as policy influencers in shaping domestic low-carbon pathways. It encouraged SWFs to lead in blending finance and derisking green investments in developing markets.

While the theoretical rationale and institutional pressure for oil-based SWFs to support energy transition is well-established, practical implementation remains uneven. Norway's GPFG is a leader in fossil fuel divestment and ESG integration, but it avoids direct venture-style investments in cleantech.

Saudi Arabia's PIF, UAE's Mubadala, and Singapore's Temasek are actively investing in clean energy and technologies, but these remain exceptions, and in

many cases, fossil fuel investments continue to dominate portfolios. Many other oil-based funds (e.g., in Kuwait, Russia, Nigeria) have yet to significantly pivot toward clean energy or remain opaque about such activities.

A 2023 PwC & IFSWF report found that SWFs increased direct investments in renewables and batteries to $7.8 billion, but this is a small fraction of their total assets under management (IFSWF and PwC, 2023). Therefore, there is no global standard or widespread practice—some pioneering efforts exist, but for most funds, this transition is nascent or superficial.

Despite growing momentum, several structural and institutional barriers limit the full mobilization of SWFs for the energy transition. Clean technologies such as green hydrogen, carbon capture, and next-generation storage often require high-risk, capital-intensive, and long-horizon investment, factors that disincentivize traditional asset allocation models within SWFs.

In addition, many SWFs remain anchored in fossil-fuel-heavy sectors due to historical ties with NOCs, sectoral expertise, or revenue stabilization mandates, creating inertia against transformative reallocations.

Where domestic climate policies are vague or contradictory, SWFs also lack clear mandates to integrate energy transition objectives, undermining coherence between national commitments and investment behavior.

Finally, many SWFs lack internal expertise in evaluating cleantech markets, assessing transition risks, or forming partnerships with climate venture funds and development institutions.

In this sense, some recommendations for Aligning SWFs with the energy transition are:

1) Create dedicated Climate Investment Platforms: Establish cleantech-focused arms (e.g., Temasek's GenZero or Mubadala's Masdar) within SWFs to lead investments in high-impact sectors and emerging technologies;

2) Enhance ESG and Climate Disclosure Frameworks: Align internal reporting with global standards such as TCFD, GRI, and the One Planet Sovereign Wealth Fund Framework to increase accountability and comparability;

3) Integrate National Climate Commitments into mandates: Ensure SWF investment strategies explicitly reflect government net-zero targets and NDCs to drive alignment between sovereign policy and sovereign capital;

4) Engage in blended and de-risked finance models: Collaborate with MDBs, development finance institutions (DFIs), and climate-focused venture capital to reduce project risk and mobilize private co-investment;

5) Build internal technical and sustainability capacity: Invest in specialized personnel, training, and advisory support to enhance SWFs' ability to assess, monitor, and manage climate-aligned investment opportunities.

Therefore, oil-financed SFWs are uniquely placed to accelerate the global energy transition. Their involvement is no longer a theoretical proposal but a normative and strategic imperative. While early movers have shown the way, the broader community of SWFs has yet to operationalize this potential at scale. By

aligning their portfolios with climate objectives and embracing clean technology investment, SWFs can transform resource wealth into engines of sustainable prosperity.

## 9. Conclusion

This article has sought to reframe the debate surrounding the financing of the petroleum industry amid the global imperative for an energy transition. Rather than treating oil and gas companies as obstacles to decarbonization, it has argued for a pragmatic, integrated approach in which targeted financing mechanisms, regulatory guidance, and corporate transformation can align the industry's substantial resources and capabilities with the climate agenda.

The petroleum industry, while historically a principal source of greenhouse gas emissions, remains central to global energy security, economic development, and technological expertise. As shown, the sector controls significant infrastructure, capital, and human resources that can be redeployed toward clean energy goals, particularly through investment in CCS, low-carbon hydrogen, offshore wind, and geothermal technologies. Oil and gas companies are also key actors in hard-to-abate sectors, offering operational scale and project management skills essential to executing complex energy transitions.

The article has also demonstrated that abrupt disengagement from fossil fuel financing would be not only economically destabilizing but counterproductive to climate goals. In developing countries especially, continued oil and gas revenues are often essential to public finance and can serve as a fiscal anchor for subsidizing clean energy development.

This duality—of fossil revenues funding the transition—is already in place in several countries around the world, where the governments channel revenues into climate funds and green investment platforms. Moreover, emerging financial instruments—such as sustainability-linked loans, transition-linked reserve-based lending, and carbon abatement performance bonds—show promise in converting traditional financing tools into levers of climate accountability and innovation.

Nonetheless, the article makes clear that such financing must be conditional and transformative. Continued investment in fossil fuel infrastructure must not perpetuate a 'business-as-usual' trajectory. Instead, it should serve clearly defined transition pathways, backed by measurable climate targets, robust ESG disclosures, and frameworks that prevent greenwashing.

Financial support for the petroleum industry should be selectively deployed, focusing on emissions mitigation, diversification, and enabling technologies, and should increasingly be tied to transition outcomes rather than intentions.

A critical aspect of this strategy is the role of NOCs and SWF). These state-backed entities manage a large share of the world's hydrocarbons and revenues and represent pivotal actors in reorienting capital flows toward sustainability. The article has shown that several NOCs—including Equinor, Petronas, and Aramco—have initiated green finance programs and joint ventures in clean technol-

ogies.

Yet, financing gaps remain wide, especially in emerging economies, where concessional finance and multilateral support must play a larger role. Likewise, SWFs funded by oil rents have a unique responsibility to drive structural change by investing in future-proof, climate-aligned portfolios.

Ultimately, the article concludes that financing the petroleum industry in an energy transition landscape is not an oxymoron but a necessity, provided that such financing is designed to realign business models, reduce emissions, and catalyze broader market change. Rather than abandoning the petroleum industry, the global climate agenda must strategically engage with it, converting its inertia into momentum, and its assets into enablers of a more sustainable future.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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