Renewable Steps taken by Fossil Fuel Firms in Europe and the U.S.

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Spring 2025

I. Executive Summary

This paper investigates our central quest – How are fossil fuel firms in Europe and the United States navigating the journey of energy transition through renewable initiatives? Furthermore, what factors impact the scale, nature and ambition of their efforts? In doing so, we examine whether regional differences – such as regulatory frameworks, investor expectations, macroeconomic and market conditions – are driving divergence in decarbonization strategies among fossil fuel firms. Understanding this divergence and the underlying rationale is critical given the mounting urgency of climate action and the instrumental role that fossil fuel companies play in global carbon emissions. While these firms face increasing scrutiny and pressure to decarbonize, they also possess the infrastructure, capital and technical expertise necessary to lead in renewable deployment. Against this backdrop, exploring how firms are adapting - and what influences those adaptations – offers important insights for policymakers, investors and corporate leaders shaping the future of energy.

To answer this question, we adopted a two-part methodology, combining qualitative case studies with a quantitative project-level dataset. Our qualitative analysis examines six leading firms across Europe and U.S. – TotalEnergies, Ørsted, Repsol, and their U.S. counterparts ExxonMobil, NextEra and Chevron – to surface differences in strategy, technology focus and capital allocation. We then extended the analysis using Carbon Disclosure Project (CDP) data comprising 209 projects from 75 European companies and 50 projects from 26 U.S. firms. Projects were categorized by the type of emissions savings activity (e.g. low-carbon energy generation, energy efficiency, fugitive emissions reduction, and other categories outlined subsequently in the paper), and their corresponding impact and contribution was assessed by calculating the estimated annual CO_2 savings as a percentage of each firm's total Scope 1 and Scope 2 emissions.

Our findings reveal a distinct divergence in energy transition strategies. European firms tend to favor **broad, volume-driven** approaches, prioritizing efficiency improvements across numerous small-scale projects. This may reflect a more decentralized policy environment, stronger public accountability expectations, and the presence of a carbon tax and drilling restrictions but little to no direct subsidies for renewables. In contrast, U.S. firms more often pursue **fewer but higher-impact** projects aligned with an ROI-focused, innovation-driven culture – fueled in part by generous renewable subsidies under the Inflation Reduction Act, but in the absence of a federal carbon tax or meaningful drilling constraints. Case studies further underscore the regional distinction in energy transition approach. For example, TotalEnergies and Ørsted have aggressively restructured their portfolios around renewables, aligning with European policy and investor sentiment. U.S. firms like ExxonMobil and Chevron have embarked on a more incremental path, investing in complementary low-carbon technologies while maintaining a fossil fuel core. Meanwhile, NextEra has built the world's largest wind and solar portfolio through steady, infrastructure-based expansion within a U.S. regulatory context.

These findings suggest that there is no single template for decarbonization. Companies are responding to a complex interplay of internal constraints and external pressures. We conclude that effective energy transition strategies must be tailored to each firm's scale, financial flexibility

and regional environment – and that adopting a blend of European-style process efficiency systems thinking with U.S.-style innovation could offer a more balanced path forward.

II. Introduction

The last decade has witnessed fossil fuel firms adopting a distinct and increasing shift in focus towards incorporating a greater proportion of renewable energy in their portfolios. This phenomenon has been fueled by sustaining headwinds of environmental concerns, increasing regulatory pressures and active investor demands. The pace of transition has been further supported by the declining cost of renewable technologies with the advancement of research and development in sustainable harvesting of clean energy.

The growing emphasis and urgency of energy transition is crucial for several intricately interconnected reasons. Fundamentally, it represents an urgent need to address the growing impacts of climate change by transitioning away from carbon-intensive portfolios to new growth opportunities stemming from renewable energy sources. In the currently evolving energy landscape, a conscious, dedicated shift is necessary to enable fossil fuel firms to diversify their traditional energy mix and ensure long-term viability by investing in technological advancements to harvest renewable sources of energy more efficiently. This could also open avenues for several employment opportunities in the green energy sector and help build a more sustainable, enduring clean energy infrastructure for the future.

Fossil fuel firms have invested in a wide spectrum of project initiatives to transition towards a more decarbonized portfolio - ongoing efforts range from direct investment in renewable energy projects like wind and solar, increased capital expenditure commitments to invest in R&D for clean technologies like green hydrogen and carbon capture and storage (CCS), and process improvement strategies to improve the energy efficiency of existing processes. We note that while the trend indicates a growing focus on actions to mitigate the impacts of climate change and long-term diversification of energy sources, the scale, extent and pace of efforts vary across companies.

The world is also witnessing increased cooperation as economies across the globe are collaborating on several regulatory policies that aim to reduce greenhouse gas (GHG) emissions and move towards long-term decarbonized energy portfolios. Fossil fuels constitute the bulk of the portfolio mix of most energy majors - hence, there is considerable external pressure to move towards cleaner sources of energy and adopt more carbon-efficient processes. However, these companies also have the greatest potential to leverage their scale, infrastructure, financial resources and expertise to pioneer the expansion and adoption of renewable energy and cleaner processes.

However, this shift also presents a dilemma for these companies as they attempt to re-align their focus from the highly profitable fossil fuel resources and invest significant capex to build robust renewable energy generation infrastructure.

III. Select Case Studies

To contextualize our broader analysis, we first examine select case studies of fossil fuel firms in Europe and the U.S. These examples illustrate the varying strategic responses and operational approaches companies have adopted in their renewable transitions - often shaped by their different operational, regulatory, and competitive environments.

ExxonMobil (U.S.) and TotalEnergies (France)

ExxonMobil and TotalEnergies, prior to their renewable transitions, shared strikingly similar foundations as global, vertically integrated oil and gas giants. Both companies operated across the entire energy value chain – from upstream exploration and production to midstream logistics and downstream refining and marketing. With operations spanning more than 100 countries, they have played pivotal roles in supplying energy to the global economy. ExxonMobil, formed through the 1999 merger of Exxon and Mobil, traced its lineage to Standard Oil and was widely regarded for its engineering prowess and scale. TotalEnergies, formerly known as Total S.A., emerged through a series of French energy mergers and maintained strong state ties, with significant upstream footprints in Africa and the Middle East. Despite geographical and historical differences, both companies were structurally and strategically aligned in how they generated value – prioritizing large-scale fossil fuel operations, long-term reserve growth, and shareholder returns.

ExxonMobil's and TotalEnergies' energy portfolios during this period were heavily dominated by fossil fuels, with nearly 100% of revenue tied to oil and gas production, refining, and petrochemicals. Both companies made major capital investments in high-carbon upstream projects – including deepwater drilling, LNG infrastructure, and oil sands – while viewing natural gas as a transitional fuel rather than actively shifting toward renewables. Though they each supported early voluntary climate initiatives, such as the Oil & Gas Climate Initiative (OGCI), their responses to mounting climate science and environmental scrutiny were cautious and reactive. Financially, both ExxonMobil and TotalEnergies embraced a conservative capital philosophy, emphasizing dividend stability, cost discipline, and return on capital employed. Their in-house technological capabilities were strong – particularly ExxonMobil's research infrastructure – but were largely directed toward improving hydrocarbon efficiency rather than exploring alternative energy models. This conservative, fossil-heavy foundation would later shape and constrain the nature of each company's approach to the energy transition.

While both ExxonMobil and TotalEnergies began exploring low-carbon strategies in the past decade, the timing of their commitments to a renewable transition differed notably. TotalEnergies began signaling a strategic shift in the early 2010s and formalized this transformation with a corporate rebranding in 2021. In contrast, ExxonMobil entered the low-carbon space more cautiously, establishing its Low Carbon Solutions business unit only in 2022 and continuing to focus primarily on emissions-reducing technologies rather than renewables.

Their approaches to the energy transition have diverged significantly in terms of project focus and investment philosophy. TotalEnergies has adopted a comprehensive multi-energy

strategy, investing heavily in solar and wind infrastructure globally, with the goal of reaching 100 GW in renewable electricity capacity by 2030. Its portfolio includes utility-scale solar projects in India (through a joint venture with Adani Green Energy), a 35 MW solar plant in Angola, and growing offshore wind and battery storage capacity across Europe. In contrast, ExxonMobil has steered away from mainstream renewable generation and instead focused on low-carbon technologies that complement its core oil and gas operations. Notable initiatives include large-scale CCS projects, such as its agreement with CF Industries to store 500,000 tonnes of CO_2 annually, as well as the development of a massive hydrogen production facility in Baytown, Texas, and investments in advanced biofuels and lithium extraction to support electric vehicle markets.

These distinct pathways have fundamentally shaped what the two companies represent today. TotalEnergies is positioning itself as a diversified, integrated energy company with renewables at the center of its long-term business model. It aligns closely with European climate policy, investor expectations, and public sentiment. ExxonMobil, while making strategic bets on emission-reducing technologies, continues to operate as a petroleum-first company, committed to maximizing returns from hydrocarbons while selectively investing in technologies that may lower the carbon intensity of its existing portfolio.

NextEra Energy Resources (U.S.) and Ørsted (Denmark)

NextEra Energy Resources (U.S.) and Ørsted (Denmark) have emerged as leading figures in the global renewable energy landscape, each charting distinct paths shaped by their origins and strategic decisions. NextEra Energy Resources, a subsidiary of NextEra Energy, evolved from its predecessor, Florida Power & Light Company (FPL), in 1997. Initially focused on providing electricity to Florida, the company expanded its horizons through NextEra Energy Resources in 2001, marking a significant shift towards renewable energy investments. In contrast, Ørsted, formerly known as DONG Energy (Danish Oil and Natural Gas), was founded in 1972 with a primary focus on fossil fuels, including oil and natural gas exploration and production. This foundation positioned Ørsted as a conventional energy company deeply rooted in Denmark's energy sector.

The transition timelines and strategies of NextEra Energy Resources and Ørsted highlight their differing approaches to renewable energy adoption. NextEra began its foray into renewables in the early 2000s, completing its first wind energy project in 2002 and rapidly expanding to become North America's largest generator of wind and solar power by 2008. The company's strategy emphasized leveraging its existing infrastructure to integrate renewable projects, focusing on wind and solar energy across the United States. Notable projects include the Capricorn Ridge Wind Farm in Texas, with a capacity of 662.5 MW, and the Genesis Solar Energy Project in California, delivering 250 MW of power. In 2022, NextEra set an ambitious goal to eliminate carbon emissions from its operations by no later than 2045, underscoring its commitment to sustainable energy solutions.

Ørsted's transformation was more radical although it commenced later. In 2009, the company announced a strategic shift from fossil fuels to renewable energy, aiming to invert its energy production ratio from 85% fossil fuels and 15% renewables to 85% renewables and 15% fossil fuels by 2040. This vision led to aggressive investments in offshore wind technology,

positioning Ørsted as the world's largest producer of offshore wind energy by 2019. The company divested its oil and gas assets in 2017 and rebranded to Ørsted, reflecting its commitment to green energy. Notable projects include the development of offshore wind farms in the U.S., such as the 1,100 MW Ocean Wind 1 project off the coast of New Jersey.

Today, NextEra Energy Resources stands as the world's largest generator of renewable energy from wind and solar, with a diverse portfolio that includes wind farms, solar centers, and energy storage facilities across the U.S. The company's integrated approach, combining regulated utility operations with competitive energy solutions, has enabled it to play a pivotal role in America's clean energy transition. Ørsted has successfully repositioned itself as a global leader in renewable energy, with a strong emphasis on offshore wind projects. The company's transformation serves as a model for traditional energy companies transitioning to sustainable energy, demonstrating the viability of large-scale investments in renewables. Ørsted's commitment to biodiversity and sustainable practices further underscores its holistic approach to environmental stewardship.

In summary, while both NextEra Energy Resources and Ørsted have achieved prominence in the renewable energy sector, their journeys reflect distinct strategic choices influenced by their historical backgrounds, market environments, and corporate visions. NextEra's gradual integration of renewables within its existing framework contrasts with Ørsted's comprehensive overhaul from a fossil fuel-based entity to a renewable energy powerhouse.

Chevron (U.S.) vs Repsol (Spain)

Chevron and Repsol started out with a similar business model. Both operated as vertically integrated oil and gas giants with significant upstream and downstream presence. However, their approaches have diverged markedly in response to decarbonization strategies as part of their broader energy transition goals. Repsol is moving aggressively towards becoming a diversified energy company with material investments in renewable energy, whereas Chevron follows a more cautious approach with relatively smaller investments in renewables. In this case study, we analyze some key differences that define their strategic approach to decarbonization.

Strategic objectives and capital commitment

Repsol has incorporated energy transition as part of its core corporate strategy, announcing a commitment of 35% of its 2024-27 €16bn - €19bn capital expenditure towards low-carbon initiatives - reflecting strong commitment to redefine its existing business model. Chevron allocates majority of its capital expenditure towards traditional oil and gas energy sources, with relatively modest allocations towards renewable energy initiatives. Chevron has increased its investment in carbon capture and biofuels, but the quantum remains small relative to its overall spending.

Renewable Power Generation

Repsol is developing a large-scale, market-facing renewable energy portfolio - targeting 9-10 GW of installed renewable capacity by 2027. Chevron has focused on tapping renewables mainly to power its own operations rather than become a renewable energy producer for the market at large

- the company has committed to growing their renewable fuels capacity to 100,000 barrels per day by 2030.

Technology diversification and depth

Repsol has invested in diversifying its renewable energy capacity base, spanning investments in solar photovoltaics, onshore and offshore wind power, hydropower, battery storage and green hydrogen. This diversification reflects conscious effort to future-proof its renewable energy mix. Chevron's diversification strategy mainly emphasizes carbon capture, early-stage hydrogen, geothermal and biofuels. Chevron is also engaging in emerging technologies, but its efforts are currently in the exploration or pilot phase.

Hydrogen Strategy

Repsol and Chevron are both investing in hydrogen, but in varying capacities. Repsol has announced concrete strategies to install 550 MW of green hydrogen electrolyzers by 2025 and 1.8 GW by 2030, mainly in Spain. Chevron is exploring opportunities in both green and blue hydrogen through investments in Aurora Hydrogen and collaboration in joint ventures such as the ACES Delta project in Utah. However, Chevron's investments are relatively less organized and focused on measurable targets.

Partnerships and Risk-Sharing Models

Repsol is entering into strategic partnerships to boost its renewable strategy. Some investments like collaborations with infrastructure investors like Schroders Greencoat serve to co-finance projects. This capital recycling and diversifying of risk promotes long-term scalability. Chevron engages in partnerships with technology developers and early-stage startups to mainly focus on innovation pilots rather than building scalability for clean energy asset infrastructure.

Core business priorities and future outlook

The fundamental difference lies in the underlying objectives and forward-looking strategies that both companies have for their future business portfolio. Repsol has committed to achieve net-zero emissions by 2050 and is actively working towards re-shaping its asset portfolio accordingly. Chevron's low-carbon investments, comparatively, while ongoing and growing, are relatively lower versus its overall investment in fossil fuel energy.

IV. Data and Methodology

Based on the above case studies, we decided to analyze a broader set of fossil fuel companies across Europe and the U.S. to understand the spectrum of projects and initiatives taken by the companies in transitioning to low-carbon asset portfolios. We aimed to investigate for any similarities or differences in the categories of projects that were being prioritized across both regions, the quantum of investment, and the magnitude of CO_2 savings achieved. Our objective was to uncover significant trends or enduring patterns in the way energy companies in both these

regions approached their broader energy transition strategies towards a higher renewable mix in their future business model.

Research Design

This study employed a mixed-methods approach, integrating both qualitative and quantitative techniques to comprehensively analyze the renewable initiatives undertaken by fossil fuel firms in Europe and the U.S. This mixed-methods design was chosen to provide a holistic understanding of firm behaviors and the effectiveness of their initiatives, combining statistical analysis with contextual insights.

Data Collection

The primary source of data for this research was the Carbon Disclosure Project (CDP), a voluntary disclosure platform where companies report their environmental impacts and sustainability initiatives. The CDP data provided detailed information on carbon emissions, environmental strategies, and renewable energy projects undertaken by firms. CDP as the data source ensured access to standardized data across the regions.

This study focuses on project-level data for renewable initiatives by fossil fuel firms and corresponding firm-level carbon emission data. In order to arrive at our sample set of companies, we screened for companies across the following primary sectors: Oil & gas extraction & production, Oil & gas processing, Thermal power generation, Renewable power generation, Energy utility networks, and Coal mining.

Initial data pull for projects:

- **Europe**: 265 projects undertaken by 75 unique companies
- **U.S.**: 57 projects undertaken by 26 unique companies

The following metrics were utilized for the analysis:

- **Qualitative data** such as types of projects, including Energy efficiency in production processes, Low-carbon energy generation, etc., and their details
- **Quantitative data** such as Estimated annual CO_2 savings per project, Scope 1 emissions, and Scope 2 emissions for companies

Analysis

On the **quantitative** front, we refined our dataset by applying a minimum emissions threshold - only including projects from companies with combined Scope 1 and Scope 2 carbon emissions greater than 15,000 metric tonnes. This criterion ensured that our analysis focused on firms of meaningful operational scale. The resulting dataset included 209 projects in Europe and 50 in the U.S., for which we could compute a normalized measure of environmental impact:

Estimated Annual CO_2 Savings as a % of Total Scope 1 + Scope 2 Emissions =

Estimated Annual CO_2 Savings ÷ (Total Scope 1 + Scope 2 Emissions)

This metric allowed us to compare the relative effectiveness of projects across companies of varying sizes. We grouped projects by type - such as energy efficiency, fugitive emissions reduction, and low-carbon energy generation - and calculated the average annual CO_2 savings

percentage for each group. These averages were then visualized in region-specific charts to draw comparative insights between European and U.S.-based firms.

On the **qualitative** front, we undertook a detailed review of project descriptions to understand their design, scale, investment intensity, and intended duration of impact. We examined how these projects aligned with broader strategic narratives. Our review revealed notable differences in how companies across regions prioritized investments (e.g., volume vs. impact), approached risk, and interpreted regulatory and investor signals.

Rationale for Methodological Choices

We then integrated both strands of analyses to generate a richer understanding of how fossil fuel firms in Europe and the U.S. are navigating the energy transition. The quantitative data highlighted measurable trends in emissions impact by project category and region, while the qualitative analysis contextualized these trends within broader corporate strategies and external pressures. This integrated approach allowed us to discern both what companies are doing (through data) and why they might be doing it (through interpretation), offering insights into the underlying drivers of regional divergence in energy transition approaches.

The following sections present the findings from our qualitative and quantitative analyses, beginning with a granular breakdown of project categories and followed by a comparative assessment of regional trends.

V. Renewable Initiatives by Fossil Fuel Firms – Types of Projects (Qualitative)

At a granular level, we analyzed the individual decarbonization-focused projects by various fossil fuel firms in Europe and U.S.. The projects can broadly be classified into the following categories:

- **Energy efficiency in production processes**: Several fossil fuel majors have invested in comprehensive cost-savings projects to optimize production processes. Grassroot level initiatives as part of the broader cost-savings plans include (but are not limited to) the use of remote control systems, optimization of plant compressors, detection and prevention of water leaks, reduction of flow rates of gas routed to flare, installation of high performance air filters to improve combustion efficiency to reduce fuel gas demand, replacement of diesel generators with gas / dual generators, fuel switching projects, withdrawal escape valves, installation of oxygen analyzers, reduction of carbon emissions by replacing carbon-intensive machinery with more carbon-efficient equipment, installation of pre-heaters. Companies have also collaborated with partners such as Digital Stream Energy to take natural gas from a wellsite that would otherwise be flared and invested in several initiatives like updating of controls and automation, equipment replacement, surplus heat recovery system, steam utilization and lighting upgrades, transition from using diesel powered to electric powered fracturing fleets, reclamation of produced water to agriculture and optimized steaming patterns to rationalize production versus fuel use.

  In essence, companies have launched several small initiatives as part of a larger energy efficiency strategy plan to decarbonize various elements of their production processes.

- **Transportation:** Fossil fuel companies are transitioning to substitute their traditional car fleet with electric vehicles. Companies have updated their transportation policies and partnered with electric car companies to order e-vans and other electric vehicles for operational purposes in a phased manner to reduce their carbon footprint. Companies have also switched portions of their diesel equipment to operate on B5 and B20 biodiesel, enabled refueling onsite, adopted the use of hybrid and CNG vehicles, and are in the process of transitioning towards full-electric underground cable construction vans.
- **Low-carbon energy consumption**: Companies are investing in initiatives that lead to low-carbon energy consumption. Efforts include purchase of electricity using Guarantees of Origin (GoO) and procurement of IRECs (International Renewable Energy Certificates) to use low carbon sources of energy and offset purchased electricity requirements. Companies are also establishing self-consumption solar installers, investing in green sources of energy for operational buildings, offsetting emissions from own electricity use through retirement of emissions free energy credits (EFECs) and partnering with utility companies for renewable projects, switching fleets to renewable diesel.
- **Fugitive emissions reductions**: Companies are investing in several initiatives to reduce fugitive emissions by investing in LDAR (Leak Detection and Reduction Campaign) campaigns and improving their infrastructure by replacing materials with high leak index for better environmental protection and reduced methane emissions. Gas transportation companies are also investing in artificial intelligence and Machine Learning (ML) algorithms to optimize leak detection and repairs. Companies have increased the frequency of systematic investigations and have reduced sulfur hexafluoride (SF6) consumption and leakage by repairing problematic cubicles, updating natural gas distribution infrastructure, implementing detailed SF6 tracking and inventory, and repairing and replacing circuit breakers. Companies have also installed regenerative thermal oxidizer technology to reduce ventilation system methane emissions and used catalytic methane oxidation technologies to reduce certain low concentration ventilation system emissions.
- **Low-carbon energy generation:** Companies have invested capex in alternate renewable sources and are transitioning by acquiring / purchasing / constructing windfarms, solar photovoltaic sites, biomass and other renewable options to increase the renewable generation mix in their portfolio.
- **Energy efficiency in buildings**: Companies have invested in improving the energy efficiency in buildings to reduce power consumption through various measures ranging from cutting carbon in non-operational buildings through physical measures and improvement of user engagement and behavioral change. Companies are also consolidating space, optimizing design standards, and lighting optimization in offices and substations. Some companies have aligned with the U.S. energy efficiency classification system on the ecological footprint of buildings (LEED) by the U.S. Green Building Council and adopted the use of solar assets. Companies have also enhanced air conditioning equipment by replacing R-22 refrigerant with R-410. Companies are also promoting a single-stream recycling program to divert office waste from landfills.
- **Company policy or behavioral change**: Companies incorporated various policies to reduce electricity or heating consumption at administrative locations and adopted the use of MIDAS meters to fault-find passing valves. Companies have aligned with ISO50001 management

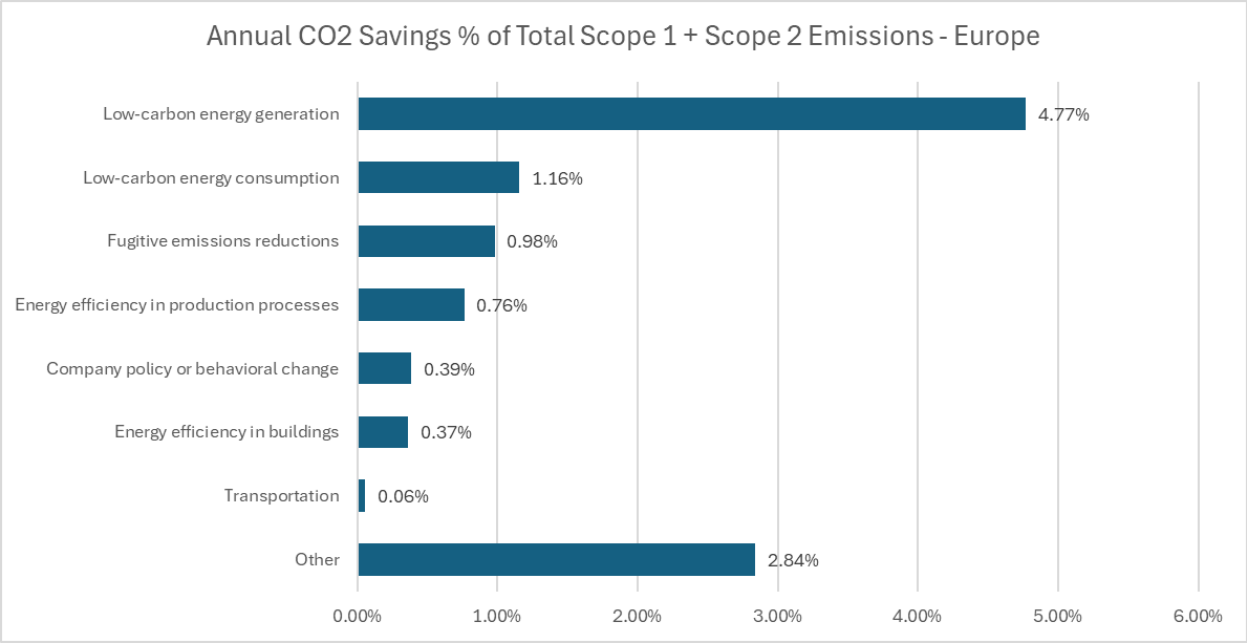
systems and are analyzing granular details and trends in their energy consumption through meter data. Companies have also adopted low-carbon travel options and mobility packages.

- **Non-energy industrial processes emissions reduction:** Companies are taking various steps to reduce emissions from non-energy industrial processes. Initiatives include retrofitting or replacing high-bleed pneumatic controllers, capturing surplus gas from a processing unit and delivering it back into the process gas stream and LDAR and pneumatic device replacement. Companies also contracted with local utilities to build a natural gas sales pipeline to ensure a dependable outlet for natural gas to avoid long term flaring, compressed natural gas to reduce flaring, and invested in gas capture and injections (increasing the capacity of the compressors) for GHG savings.
- **Waste reduction and material circularity:** Companies have engaged in several initiatives to improve waste reduction and increase material circularity. Efforts include H2S recovery, flare reduction strategies, separate collection and recovery of material resulting in reduction of atmospheric emissions and reuse as second raw material. Companies have also reduced the amount of scrap metal held, monitored the weight of the metal that is weighed in for recycling, monitored frequency of skip removal and investigated pattern changes.
- **Other**: Companies have also invested in several initiatives that do not fall within any of the above categories. For example, companies have implemented projects to optimize energy center operations and enabled their clients to achieve energy savings. Other initiatives also include the use of alternative fuels in drilling and completion operations, reduction of flaring gas in operations, and closed-loop gas capture and recycling projects. Companies are conducting leak survey programs and implementing drafting, cross compression, flaring and project bundling to reduce the amount of natural gas released during construction and repair projects on gas transmission systems. Companies have also installed vapor recovery units, replaced or retrofitted natural gas-powered pneumatic equipment and implemented Best Available Control Technology (BACT) in new operations.

VI. Comparative Analysis: Europe vs U.S. (Quantitative)

Europe

Europe	Annual CO2 Savings % of Total Emissions	No. of projects
Low-carbon energy generation	4.77%	41
Low-carbon energy consumption	1.16%	7
Fugitive emissions reductions	0.98%	25
Energy efficiency in production processes	0.76%	93
Company policy or behavioral change	0.39%	2
Energy efficiency in buildings	0.37%	15
Transportation	0.06%	9
Waste reduction and material circularity	nm	1
Non-energy industrial process emissions reduc	nm	2
Other, please specify	2.84%	14
Total / Average	**1.68%**	**209**



Commentary:

Several interesting trends can be inferred from the above data:

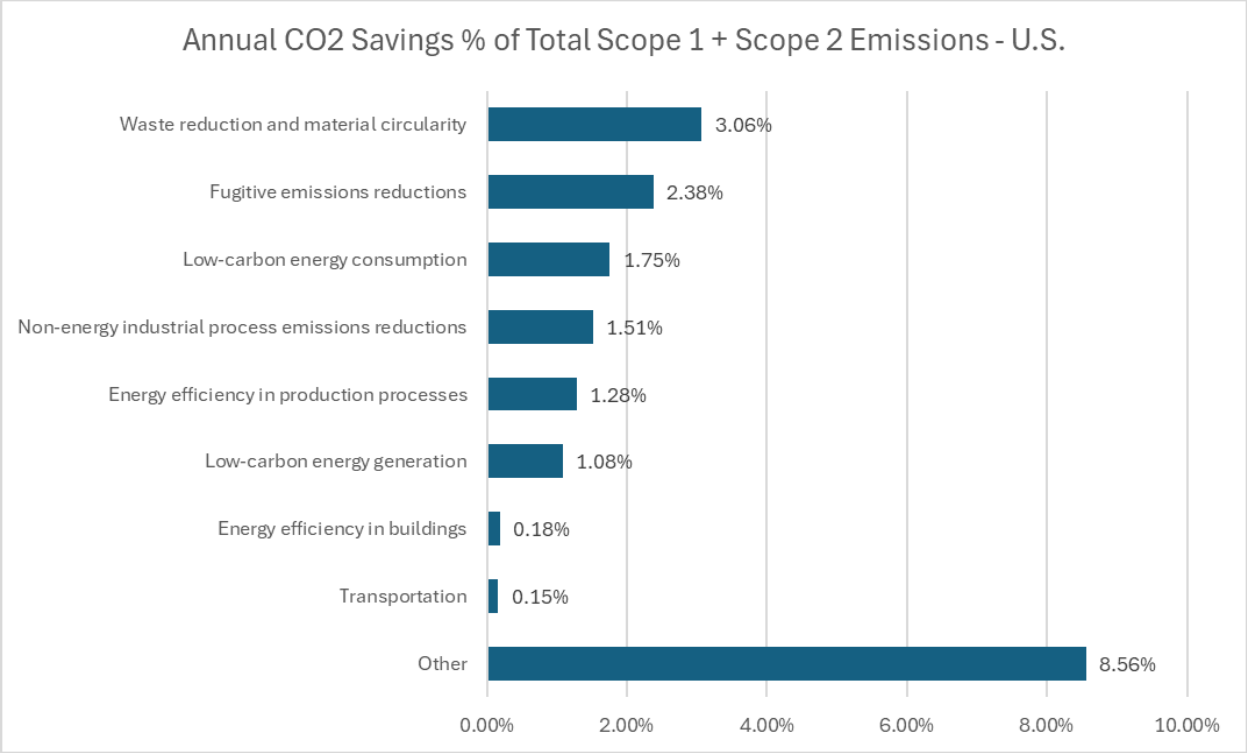
- Low-carbon energy generation focused projects lead to the highest annual CO_2 savings per project as a % of total emissions. However, currently, companies in Europe are investing in a greater number of projects focused on realizing energy efficiency in production processes (93 projects in this category vs. 41 low-carbon energy generation projects) which relatively have a much lower % of CO_2 savings per project (0.76%)
- This trend suggests that companies prefer a volume-driven approach of investing in a larger number of relatively lower-emission reduction projects vs. projects that lead to higher CO_2 savings. There could be several reasons underlying this preference:

- **High CO_2 savings projects could also be more capital-intensive.** It is possible the CO_2 savings per dollar invested, coupled with probability of success, may not be economically viable for smaller companies
- **Higher emission projects may have a longer payback period.** Given the constantly evolving regulatory landscape, investing in longer term projects could be risky as companies must be prepared to adapt and make changes as new policies get announced

- Overall, this trend suggests that companies are focusing more on improving and decarbonizing existing processes rather than direct investments in renewable sources of energy to achieve their decarbonization objectives

United States

United States of America	Annual CO2 Savings % of Total Emissions	No. of projects
Waste reduction and material circularity	3.06%	3
Fugitive emissions reductions	2.38%	10
Low-carbon energy consumption	1.75%	5
Non-energy industrial process emissions reduc	1.51%	5
Energy efficiency in production processes	1.28%	9
Low-carbon energy generation	1.08%	1
Energy efficiency in buildings	0.18%	5
Transportation	0.15%	5
Company policy or behavioral change	na	0
Other, please specify	8.56%	7
Total / Average	**2.47%**	**50**



Commentary:

- We note that the number of projects voluntarily reported by U.S.-based companies is lower vs. European companies, likely driven by varying regulatory policies in both regions
- Furthermore, the project categories leading to a greater proportion of annual CO_2 company savings in the U.S. is not the same as the project categories in Europe
- As can be seen, innovative projects that do not fit into any specific category (Others) lead to the highest annual CO_2 savings (8.56%), followed by projects focusing on waste reduction and material circularity (3.06%) and fugitive emissions reductions (2.38%)
- Another interesting pattern in the U.S. is that companies seem to prioritize projects that lead to higher annual CO_2 savings per project rather than following a volume-driven approach

Strategic Implications and Recommendations

In addition to company-specific factors such as scale and affordability that influence investment decisions for projects, region- and market-specific factors such as policy, investor expectations, and accountability also seem to shape company behavior. For example, the dispersion of effort across smaller projects in Europe may reflect a more decentralized policy environment within the EU, where individual country regulations can shape firm-level decisions differently. It may also reflect stronger public accountability norms, where consistent visible action – even if incremental – can play a signaling role for stakeholders. On the other hand, the relative concentration of projects in a few high-yield categories may suggest a more ROI-focused approach to decarbonization in the U.S., aligning with shareholder-centric governance structures prevalent in the region.

These strategic behaviors are further influenced by divergent policy tools: Europe relies on carbon pricing mechanisms and drilling restrictions but provides limited direct subsidies for renewables. In contrast, the U.S. lacks a national carbon tax and imposes fewer drilling constraints but has implemented substantial renewable subsidies. This asymmetry in policy tools impacts not only the types of projects pursued but also the pace and visibility of corporate decarbonization efforts.

These findings suggest that there is no single optimal pathway to decarbonization. Instead, companies must tailor their strategies to their scale, regulatory exposure, and financial capacity. Large firms with long investment horizons may find value in pursuing capital-intensive projects that would help diversify their portfolio through renewable energy generation processes, whereas, smaller or capital-restricted firms may benefit from projects focusing on efficiencies in existing energy generation processes with higher probability of success. We therefore recommend that companies integrate their risk appetite, capital structure effects, and regulatory expectations into their decarbonization strategies.

VII. Conclusion – Decarbonization Pathways: No One-Size-Fits-All

Our analysis reinforces the critical role that operational environments play in influencing the energy transition strategies of fossil fuel firms. Across both the qualitative case studies and quantitative analysis, our findings indicate that regional regulatory frameworks, investor expectations and energy market structures deeply influence the timing and scope of companies' strategic actions.

European firms, operating under more stringent climate regulations and benefiting from strong policy alignment, have generally pursued comprehensive, portfolio-level shifts - often embedding renewables at the core of their business models. In contrast, U.S. firms, navigating a more fragmented and politically variable landscape, have tended toward incremental, technology-specific approaches, often prioritizing emissions-reduction technologies that complement their existing fossil-based operations. This divergence reflects not only different regulatory pressures but also distinct philosophies around risk, capital allocation, and long-term value creation.

These varied strategies carry important implications for the future of the global energy transition. The European model, typified by firms like Ørsted and TotalEnergies, suggests that systemic transformation - with renewables positioned as growth engines - can be achieved when policy certainty, investor alignment, and corporate intent converge. The U.S. model, as exemplified by ExxonMobil and Chevron, underscores the challenges of shifting core business strategies in less coordinated policy environments, but also highlights the potential for innovation in low-carbon technologies. As the urgency of decarbonization intensifies, the path forward may not lie in choosing one model over the other, but in synthesizing elements of both - combining the scale and systems thinking of European transitions with the technological experimentation and entrepreneurial risk-taking observed in the U.S. This synthesis will be vital for fossil fuel firms seeking to navigate an increasingly carbon-constrained world while preserving shareholder value and securing long-term relevance in the evolving energy economy.

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IX. Appendix

Select Key Renewable Transition Initiatives by each company covered in the case studies:

To compile the list of renewable energy initiatives undertaken by the six fossil fuel companies, we leveraged a variety of sources. We began by reviewing the companies' official websites, including sustainability reports, annual filings, and press releases. We supplemented this research through news searches, using keywords related to each company's renewable energy activities to identify notable projects and strategic developments.

TotalEnergies

- **2011**: Acquired a 60% stake in SunPower, a U.S.-based solar panel manufacturer, marking its significant entry into the solar energy sector
- **2016:** Acquired Lampiris, a Belgian green energy supplier, marking its entry into the distribution of gas and electricity
- **2016**: Purchased Saft Groupe S.A., a French battery manufacturer, for €950 million to enhance its energy storage capabilities
- **2017:** Acquired a 23% stake in Eren RE, specializing in wind and solar energy production, and acquired GreenFlex, focused on energy optimization
- **2018:** Purchased 74% of Direct Énergie, a French electricity and gas supplier, adding gas-fired power plants and renewable projects to its portfolio
- **2020:** Acquired EDP's portfolio in Spain, including 2.5 million residential gas and electricity customers and two gas-fired power plants, expanding its presence in the Spanish market
- **2021:** Acquired a 20% stake in Adani Green Energy, an Indian renewable energy company, and announced plans to invest in 35 GW of gross production capacity from renewable sources and storage by 2025, aiming for 100 GW by 2030
- **2022:** Acquired Core Solar, a U.S.-based renewable energy company, and a 50% stake in Clearway Energy Group, the fifth-largest U.S. renewable energy player, adding significant capacity to its renewable portfolio
- **2024:** Announced the acquisition of VSB Group, a German renewable energy company, further expanding its European renewable energy footprint
- **2023**:
    - Acquired three gas-fired power plants in Texas with a total capacity of 1.5 GW to complement its renewable energy assets and ensure grid stability
    - Invested £20 million in the Xlinks Morocco–UK Power Project, aiming to supply renewable electricity from Morocco to the UK via a subsea cable
- **2024:** Launched three renewable electricity projects in Oman, including two wind farms and a solar power plant, with a combined capacity of 300 MW

ExxonMobil

- **2010s**: ExxonMobil invested in research on algae biofuels, aiming to develop sustainable fuel alternatives
- **2018**: Announced a $100 million partnership with the U.S. Department of Energy to advance lower-emission energy technologies, including carbon capture and biofuels

- **2021**: Established the Low Carbon Solutions division, focusing on carbon capture and storage (CCS), hydrogen, and biofuels to reduce emissions in hard-to-decarbonize sectors
- **2022**: Acquired Biojet AS, a Norwegian biofuels company, to expand its biofuels portfolio
- **2023**: Acquired Denbury Inc., a company specializing in enhanced oil recovery and CCS, for $4.9 billion to bolster its carbon capture capabilities
- **2024**:
    - Entered into a joint study agreement with JERA to explore the development of a low-carbon hydrogen and ammonia production project at its Baytown Complex in Texas
    - Abu Dhabi National Oil Company (ADNOC) acquired a 35% stake in ExxonMobil's Baytown hydrogen project, aiming to produce 1 billion cubic feet per day of blue hydrogen

Ørsted

- **2009:** Announced a strategic shift from fossil fuels to renewable energy, aiming to invert its energy production ratio to 85% renewables by 2040
- **2017:** Divested its oil and gas assets and rebranded from DONG Energy to Ørsted, reflecting its commitment to green energy
- **2019:** Became the world's largest producer of offshore wind energy, achieving a renewable-generation share of 86%
- **2023:** Completed the 132 MW South Fork Wind farm off the coast of New York, providing clean power to over 70,000 homes
- **2023:** Began local construction work on the 704 MW Revolution Wind project, expected to be fully operational by 2026, supplying clean energy to over 350,000 homes in Rhode Island and Connecticut

NextEra Energy Resources

- **2002:** Completed its first wind energy project, marking the company's initial foray into renewable energy
- **2008-2009:** Developed several wind energy centers across multiple U.S. states, significantly expanding its wind energy portfolio
- **2018:** Sold its Canadian wind and solar generation portfolio to the Canada Pension Plan Investment Board for $582.3 million
- **2022:** Set a goal to achieve zero-carbon emissions by no later than 2045
- **2024:**
    - Announced plans to invest $12 billion in solar energy and $1.5 billion in battery storage from 2024 to 2027
    - Reported having 31 GW of clean energy in operation and plans to build approximately 36.5 GW to 46.5 GW of new wind, solar, and energy storage projects

Repsol

- **2019:** Repsol became the first oil and gas company to commit to achieving net-zero emissions by 2050, marking a significant shift in its corporate strategy towards sustainability
- **2021:** Acquired a 40% stake in U.S.-based Hecate Energy, expanding its presence in the U.S. solar and battery storage markets
- **2022:** Purchased Asterion Energies, adding 7.7 GW of renewable projects in Spain and Italy to its portfolio
- **2024:** Completed the construction of the Frye Solar project in Texas, its largest photovoltaic plant to date, with a total installed capacity of 637 MW
- **2025:**
    - Started producing electricity at the 364 MW Antofagasta wind farm in Chile, its largest wind project and one of the largest in the country
    - Approved the construction of an Ecoplant in Tarragona, Spain, with an investment of €800 million. The plant will process 400,000 tons of municipal solid waste annually, converting it into 240,000 tons of renewable fuels and circular products

Chevron

- **2010:** Launched Project Brightfield, a 740-kW photovoltaic demonstration project in Bakersfield, California, to explore solar power applications
- **2011:** Commissioned a 29 MW thermal solar-to-steam facility at the Coalinga Oil Field in California, using solar energy for enhanced oil recovery
- **2021:** Established Chevron New Energies, committing $10 billion through 2028 to develop lower-carbon technologies, including carbon capture, hydrogen, and renewable fuels
- **2022:** Acquired Renewable Energy Group (REG) for $3.15 billion, becoming one of the largest producers of biodiesel in the U.S.
- **2023:**
    - Began construction of a solar field in Hayhurst, New Mexico, designed to meet all the electricity needs of a Chevron facility, contributing to its carbon reduction goals
    - Entered into a joint study agreement with Pertamina and Keppel to explore the development of lower-carbon hydrogen and ammonia projects using renewable energy in Sumatra, Indonesia
- **2025:** Partnered with Engine No. 1 and GE Vernova to develop up to 4 GW of power for U.S. data centers, leveraging renewable energy sources