Real Energy:

The Now & Future Role of Oil and Gas in Climate Scenarios

An Adamantine White Paper

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ADAMANTINE ENERGY

Executive Summary

Climate scenarios have become a critical part of business and policy planning for the energy future. They enable standard, quantifiable comparisons between alternative versions of the future, help reveal the levers and actions that produce those versions, and catalyze critical thinking about the future of global energy. These scenarios are used by investors, the public, and policymakers as the basis for decision making—often for decisions material to the industry.

Despite their considerable value, climate scenarios are increasingly misinterpreted and miscited to oversimplify the accessibility of and need for a fossil-fuel-free future. Our analysis of 20 different publicly available climate scenarios shows that they tell a different story—one that emphasizes the current and future role of oil and gas in a decarbonizing energy future.

We present our findings to (a) dispel the misconception that in order for the world to reach its climate goals, we must cease oil and gas use and (b) alert oil and gas leaders that these scenarios represent an opportunity to gain competitive advantage in the real decarbonization economy. The opportunity for oil and gas leaders is to join the conversation by articulating their plans for the future—thereby informing rather than reacting to conversations about climate and energy scenarios.

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Our team at Adamantine examined a diverse set of climate scenarios to gain insight into the projected role of oil and gas in a low-carbon future. Our hypothesis: Under every scenario—even the most climate-ambitious, in which fossil fuel use decreases the fastest—oil and gas would remain a part of both the North American and the global energy mix through 2050. If our hypothesis

were to prove correct, it would have profound ramifications for the planning of a wide variety of companies in oil and gas. We surveyed 20 different publicly available climate scenarios to gauge (a) the projected life span of the industry under each scenario and (b) the dependence of the scenarios on oil-and-gas-adjacent technologies and infrastructures (e.g., hydrogen, geothermal, and carbon capture).

Our findings confirmed our hypothesis. Even the most ambitious climate scenarios forecast that oil and gas will remain a part of the energy mix through 2050, and all but one of the scenarios examined indicate that we will need more oil-and-gas-adjacent technologies to reach our collective climate goals. In this report, we cover our findings and ultimately recommend that you, the oil and gas leader,

- Understand the pervasive role oil and gas plays in all scenarios, even those scenarios routinely mischaracterized as involving no significant fossil energy.
- Conduct an internal scenario analysis at your company, assessing the opportunities and risks ahead to form your long-term strategy around the energy transition.
- Articulate how your company will be the best choice for the last barrel, which will be a low-carbon barrel.
- Explore your company's profitable growth options in oil-and-gas-adjacent low-carbon businesses.

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In the pages ahead we (a) analyze climate scenarios to understand the role played by oil and gas, (b) take away three themes from this analysis, and (c) translate these insights into recommendations for industry leaders.

Our Climate Scenario Analysis: **The Persisting Role of Oil & Gas**

Adamantine examined a diverse set of 20 different publicly available climate scenarios from leading international organizations and corporations to gauge the projected life span of the oil and gas industry. They were selected as a representative mix of the most often cited studies. To test our hypothesis, our analysis looked at the scenarios' dependence on oil-and-gas-adjacent technologies and infrastructures as well as the outlook for the industry as a whole. We specifically selected scenarios that are commonly referenced by investors, stakeholders, and policymakers as leading indicators.

To assist with the quantitative analysis, we utilized Resources for the Future's (RFF) *Global Energy Outlook 2022*[1] report and publicly available interactive data tool[2] to visualize and compare normalized data from a similar set of climate scenarios.

The scenarios vary because of differences in modeling techniques, historical data, baseline assumptions, and policy projections. Generally, scenarios can be grouped into three categories, defined by RFF: (1) *reference*, which assume no major policy changes; (2) *evolving policy*, which

incorporate the modeling team's expectations of policy trends; and (3) *ambitious climate*, which limit global mean temperature rise to 2 degrees Celsius or lower. We examined projections from the following entities: the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), Equinor, Shell, BP, the Network for Greening the Financial System (NGFS), and Bloomberg, with 20 total scenarios. Ten of the scenarios examined were defined as ambitious climate, five as reference, and five as evolving policy. Figure 1 lists the examined scenarios with their respective sources.

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Figure 1: Climate Scenarios Examined in this Report

Source	Report	Scenarios
Bloomberg	New Energy Outlook 2022	Economic Transition Net Zero
BP	Energy Outlook 2022	New Momentum Accelerated Net Zero
Equinor	Energy Perspectives 2022	Walls Bridges
International Energy Agency (IEA)	World Energy Outlook 2022	Announced Pledges (APS) Stated Policies (STEPS) Net Zero Emissions by 2050 (NZE)
International Renewable Energy Agency (IRENA)	Global Renewables Outlook (2020)	Planned Energy (PES) Transforming Energy (TES) Deeper Decarbonization (DDP)
Network for Greening the Financial System (NGFS)	Climate Scenario Portal	Nationally Determined Contributions Delayed Transition Net Zero 2050 Below 2C
Shell	The Energy Transformation Scenarios (2021)	Islands Waves Sky 1.5

(Note: reference, evolving policy, ambitious climate)

The State of Play in Climate Scenarios

Even with variations across scenarios, common themes relevant to the future of the oil and gas industry emerged. We found that most scenarios we examined (a) project considerable growth in total primary energy demand, (b) confirm that natural gas and oil will continue to play meaningful roles in the global energy system, and (c) show that oil-and-gas-adjacent technologies are and will be critical to decarbonization. These findings are explored below.

1. **Most of the scenarios show a range of energy sources will be required to meet growing energy demand—including oil and gas.**

Most of the scenarios project considerable growth in total primary energy demand, defined as the sum of demand for coal, oil, gas, nuclear, hydroelectric, wind, solar, and other renewable energy, excluding electricity and heat (though the inputs to generate electricity and heat are inherently included).[3] In RFF's Global Energy Outlook tool, some scenarios show demand increasing significantly, such as Shell's Waves scenario, which projects a 53 percent rise from 2020 levels by 2050. Other scenarios project more modest growth, including the IEA's APS (14 percent) and STEPS (26 percent). Under several ambitious climate scenarios, global demand is projected at 8 percent to 13 percent lower than 2020 levels, largely attributed to advances in efficiency and electrification, and behavioral changes. To place these figures in perspective: the 30-year period from 1990 to 2020 saw a 57 percent increase in global energy demand.[4]

Most of the scenarios agree that both oil and natural gas will be required to satisfy global energy demand under almost any future market scenario—even ones in which policies increasingly aim to limit fossil fuel use and reduce GHG emissions, such as the IEA's NZE.

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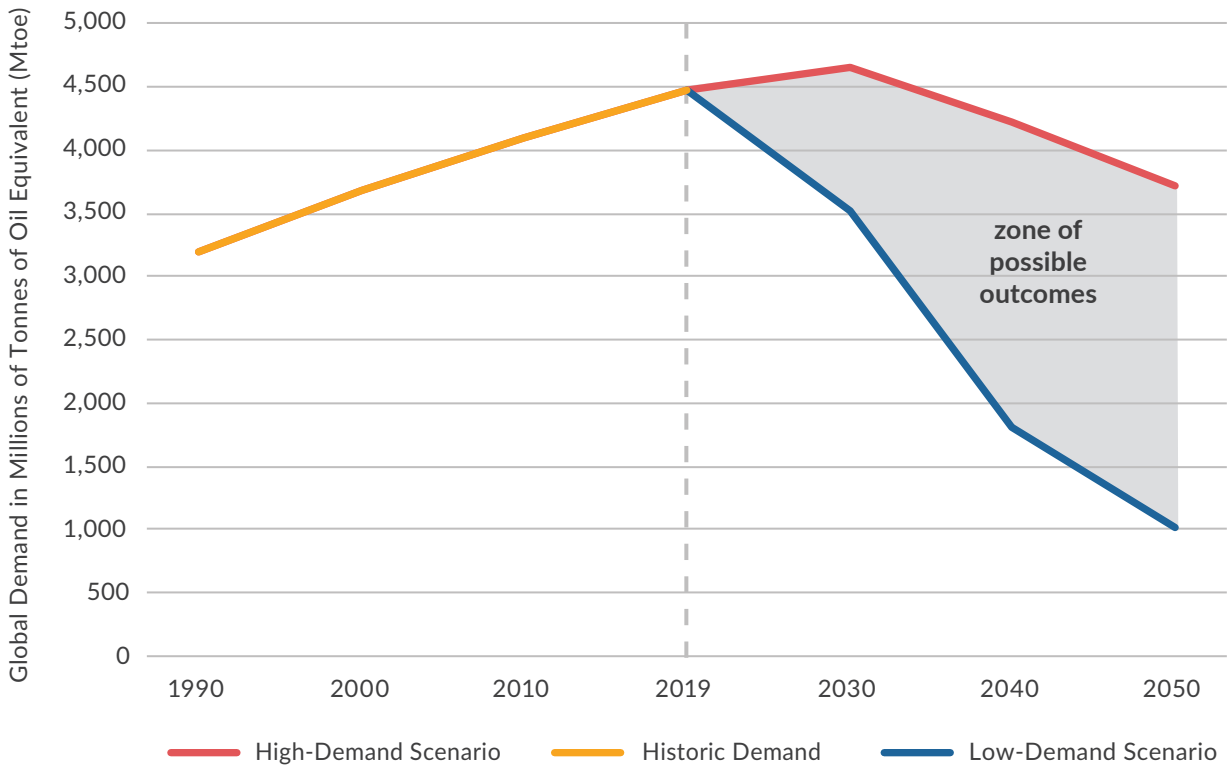
Fossil fuels' share of demand will decrease from 2020 to 2050 under almost all of the scenarios, but their aggregate level may increase. According to BP's Statistical Review of World Energy,[5] fossil fuels, including coal, oil, and natural gas, provided 80 percent of the world's primary energy supply in 2020. By 2050, under most of the scenarios, the share of fossil fuels in the primary energy mix will have declined. Projections in oil and gas demand reduction range from 53 percent to 41 percent, depending on how climate-ambitious the scenario is. Most reference and evolving-policy scenarios we examined, however, suggest that aggregate level of fossil fuels in the primary energy mix will increase.

2. **Both oil and gas will remain a significant part of the energy mix through 2050—though the mix won't look the same as today's.**

As Figure 2 illustrates, across high- and low-demand projection scenarios, oil remains a part of the energy mix. The projections can be grouped on the basis of several fundamental differences in assumptions:

- **Reference and evolving-policy scenarios show steady or increasing oil demand through midcentury.** Global demand ranges from 86 million barrels per day (mb/d) (Equinor's Walls) to 104 mb/d in 2050 (IEA's STEPS), including oil and byproducts.
- **In contrast, ambitious climate scenarios show gradual declines in oil demand from 2021 through 2030, followed by a steeper decline from 2030 to 2050.** Demand decreases in these scenarios range from 18 mb/d by 2050 (IEA's APS) to 69 mb/d (Equinor's Bridges).
- **Among ambitious scenarios, a key driver of projected oil demand is the assumed deployment of carbon capture and sequestration (CCS).** Interestingly, the greater the deployment of CCS and other negative-carbon-emissions technologies, the slower the decline in oil use. Shell's Sky1.5 scenario, for instance, shows a gradual decline in oil demand, with a total reduction of 16 mb/d by 2050 coupled with widespread deployment of CCS.
- **In contrast, scenarios with low CCS reliance project the greatest oil demand reductions.** IRENA's Deeper Decarbonization and IEA's NZE, for example, show demand dropping 86 mb/d and 77mb/d by 2050, respectively.

Figure 2: Range of Global Oil Demand Scenarios



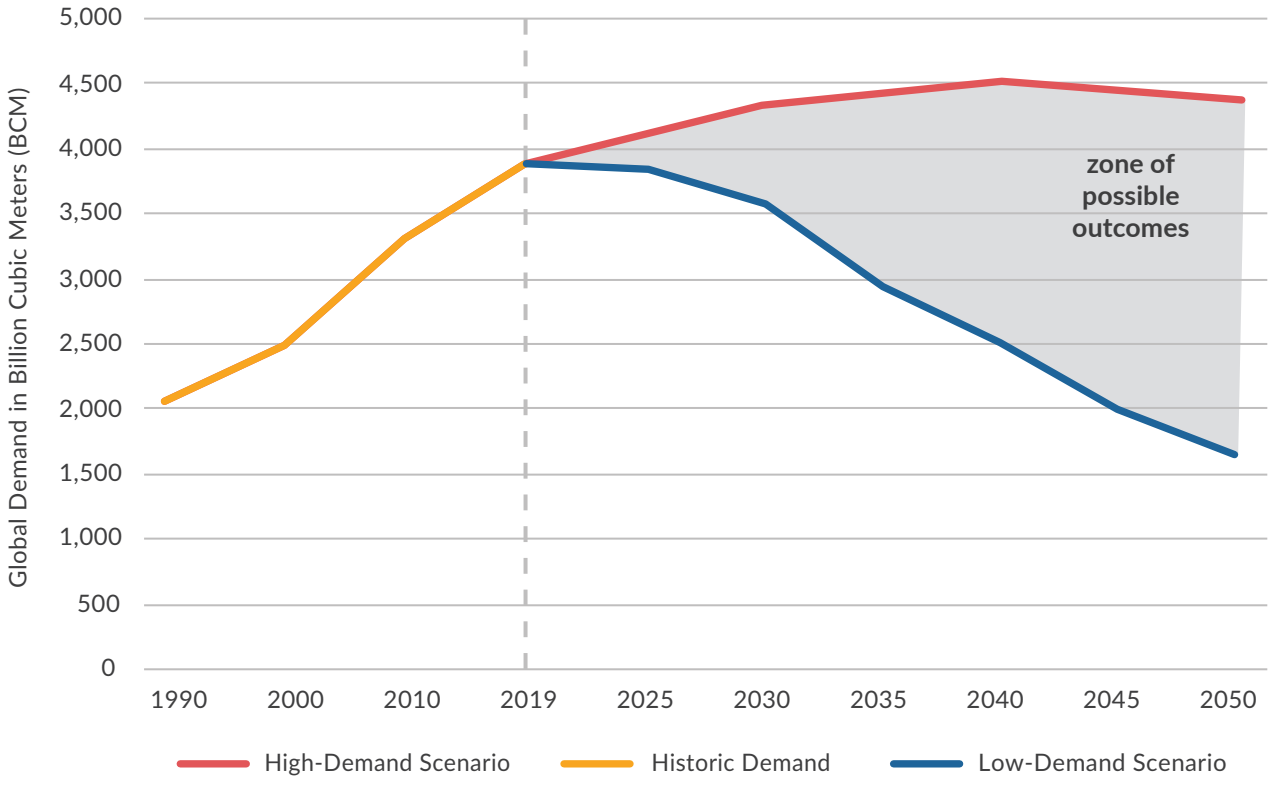
(Source: Equinor, IEA)

In the case of natural gas, the range of projected demand in 2050 is considerably wider than that of oil. For context, from 2000 to 2022, global natural gas demand grew by roughly 51 trillion cubic feet (tcf). Figure 3 shows the projected natural gas use under low- and high-demand scenarios.

The projections for gas are grouped by similar themes to those of oil:

- **Natural gas demand remains fairly steady through 2025** under all scenarios, but large differences emerge in the subsequent 5 to 10 years.[6]
- **Most reference and evolving-policy scenarios project higher demand through 2050.** Reference and evolving-policy scenarios project considerable demand growth for natural gas; however, most envision the bulk of demand boosts to come between now and 2030, with demand plateauing from 2030 through 2050. By 2050, projected increases in global demand range from 13 tcf (IEA APS) to 14 tcf in 2050 (Equinor Walls).
- **All ambitious climate scenarios envision lower natural gas demand in 2050 than 2021.** Demand decreases in these scenarios range from 78 tcf by 2050 (IEA NZE) to 105 tcf (Equinor Bridges).
- **In most, demand drops considerably by 2030,** except for BP Accelerated, BP Net Zero, and Shell Sky1.5; these scenarios rely heavily on large-scale CCS deployment. By 2050, around 45 percent of the natural gas consumed in BP's Accelerated and 80 percent in BP's Net Zero is offset by means of CCS.
- **As with oil, the deployment of CCS is the key differentiator** between current and future natural gas applications.

Figure 3: Range of Global Natural Gas Demand Scenarios



(Source: Equinor, BP)

3. **Oil-and-gas-adjacent technologies are critical to decarbonization.**

Improvements in technology can reduce energy costs, lower emissions, and influence the energy mix by changing the relative competitiveness of different energy types. The most prominent areas of investment include CCS, hydrogen, and geothermal. All three leverage existing oil and gas infrastructure, technology, and competencies.

About 65 percent of scenarios include CCS as a critical component to reaching climate goals. These scenarios, including the IEA's, Shell's, and BP's climate-ambitious scenarios, list CCS as a key part of the decarbonized energy system. IEA's climate-ambitious NZE scenario cites CCS for its ability to unlock faster decarbonization of carbon-intensive production processes such as cement manufacturing. Carbon capture volumes are projected to increase marginally over the next five years, with projects currently under development, then undergo a period of rapid development over the following 25 years as "policy action bears fruit," as the IEA's NZE scenario describes that evolution. The IEA notes, "The oil and gas industry is already one of the global leaders in developing and deploying carbon capture and sequestration (CCS) technologies. Of the 35 megatons of carbon dioxide captured today from industrial activities in large-scale CCS facilities, nearly 80% is captured from oil and gas operations."[7] In our view, as an industry that undertakes well-funded, large-scale engineering projects in pipeline and subsurface technologies, oil and gas is best suited to lead the growth in CCS.

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About 30 percent of scenarios include hydrogen production. Under some scenarios, including IEA's APS, demand for blue and green hydrogen could more than triple by 2050 with cost reductions and infrastructure build-outs. The even more climate-ambitious IEA NZE scenario argues that although the energy transition represents a "clear threat" to oil and gas earnings, there is immense opportunity in the pursuit of oil-and-gas-adjacent technologies and low-emissions gases that will see a rapid demand increase: "Oil and gas exporters seeking ways to guarantee long-term markets for their resources may also need to start considering carefully the potential for hydrogen, including options for its transportation to consumers, if it is to offer a long-term alternative to trade in hydrocarbons."[8] Without the support of the oil and gas industry, these technologies may never reach the level of maturity where they can supply the hard-to-decarbonize industrial, long-haul-trucking, and shipping sectors cost-competitively.

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About 35 percent of scenarios incorporate geothermal energy in the power mix. Geothermal energy plays a major role in power production in climate-ambitious scenarios, including BP's Accelerated and Net Zero scenarios, which forecast geothermal, nuclear, hydro, and bioenergy will account for around 25 percent of power generation in 2050. The IEA NZE scenario identifies 52 gigawatts (GW) of geothermal capacity for deployment by 2030 in a net-zero scenario (compared with just 15 GW installed capacity at present) and 126 GW capacity needed by 2040. The oil and gas industry's knowledge and expertise are highly aligned with the skills and technologies needed for widespread implementation of geothermal energy. Utilizing

abandoned or unproductive wells to harness geothermal energy, for example, offers a clear opportunity for oil and gas to enter the renewable space while ensuring the safe retirement of existing wells. The oil and gas industry is best suited to scale these technologies.[9]

Recommendations: **Take Control of the Narrative**

These findings shouldn't make oil and gas leaders complacent. We know that oil and gas are here to stay, but companies and their operations will look meaningfully different in the years ahead. Scenarios indicate that the energy world will cleave quickly into those committed to leading in decarbonization and those who will be left behind. Now is the critical time for you to act—to best position your company to benefit from the possibilities indicated by these scenarios. We recommend that you implement the following three steps:

1. **Conduct an internal scenario analysis to know where you fit in.** Understanding the external scenarios is just the first step. Stress-testing your company portfolio against climate scenarios in a process known as scenario analysis requires you to review your operations in light of specific emissions goals outlined in the various scenarios, evaluate and explain abatement options, assess future impacts to your asset base, integrate capital and strategic planning, and disclose and engage with relevant stakeholders.[10] We recommend that our clients conduct their own scenario analyses—which can meet several complementary ends:
    - **Meet TCFD and CDP expectations.** There has been an increasing focus on using the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) or responding to the prompts of the CDP's climate change questionnaire, both of which incorporate climate scenario analysis.
    - **Better understand your unique risks.** Creating your own scenarios allows your company to wrestle with input assumptions and glean quantified insights from the analysis. This process allows company leaders to better understand potential long-term risks, gain insights into associated commercial opportunities, and make informed investment decisions to manage both.
    - **Tell your story about how you fit in to expectations to decarbonize.** Public pressure to address climate change is not going anywhere. Employees, investors, community members, policymakers, and customers will want to know where your company fits in to a decarbonizing energy future. Conducting scenario analyses allows you to participate meaningfully in discussions about an unknown energy future, articulating the ways in which you fit in to different scenarios. Doing so adds important risk mitigation to your company's resilience strategy, keeping important conversations open and influencing relevant policy factors.

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2. **Explain why you're the best choice for the last barrel.** At Adamantine, we believe that the last barrel will be the lowest-carbon barrel. What does that mean? According to BP's Accelerated scenario, tightening policy on carbon emissions will affect the choice of opportunities for investment in new oil production, including choices between brownfield and greenfield sites, with investment tending toward the most resilient, lowest-carbon resources.[11] As part of narrating your company's role in the energy future, we recommend that you

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- **Develop and report short- and long-term emissions reduction targets.** Companies are expected to do everything within their power to lower the emissions profile (and therefore the carbon intensity) of their business. Companies are expected to create aggressive—yet achievable—targets, and disclose the details on their plans to achieve them. Successful companies will demonstrate their progress transparently and in good faith, including detailed annual performance analysis.

- **Build a more resilient core business.** Energy markets will face volatility driven by geopolitical tensions and ever-changing demand. Although most climate scenarios do not publish oil price projections, we can extrapolate from price projections of the IEA and U.S. Energy Information Administration (EIA). Like projections for future fossil fuel demand, 2050 prices have a very wide range, from $24 per barrel (bbl) in the IEA NZE to $95/bbl in IEA STEPS, to $170/bbl for Brent crude in the U.S. EIA high-oil-price scenario.[12] Companies will want to build a portfolio that can weather both lower commodity prices and higher carbon prices. To help your company remain resilient, implement no-regrets decarbonization of your operations and supply chain. Build high-grade portfolios toward advantaged growth opportunities, pursuing the best combination of lower break-even prices and lower emissions intensity.

3. **Explore profitable growth options in low-carbon businesses.** So far, investment by oil and gas companies outside their core business areas has been less than 1 percent of total capital expenditure[13]. Part of building a compelling vision for your company in the low-carbon future is backing it up with discerning investments. As explored in the book *Real Decarbonization*, each company's approach will be unique. Here's where to get started:

   - **Diversify into oil-and-gas-adjacent tech.** The lowest-hanging fruit for oil and gas companies are those opportunities that repurpose industry expertise and resources. Carbon capture, CO_2 transport, CO_2 sequestration, direct air capture, hydrogen production and transport, and renewable fuels will all play meaningful roles in the decarbonizing future. Decarbonization projects and investments should support the core business, be accretive to the bottom line, and include only a tolerable amount of risk.

   - **Leverage your competitive advantage.** Every company has its own, unique competitive profile. From ultra-low-cost production to world-class community relations, discuss strategies to leverage your advantages to provide more value for your stakeholders as you invest in the energy future.

   - **Make tangible commitments.** Articulate a plan for participating in the energy future by showing tangible commitments to low-carbon projects, taking on the risks and capital commitments associated with those projects. Improve existing operations and focus on existing infrastructure, environmental, and social performance.

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Take Your Strategy to the Next Level

In this report, Adamantine has taken on the misperception that decarbonization scenarios prescribe a future without oil and gas. However, that doesn't mean that oil and gas companies can maintain business-as-usual operations. In fact, we believe that only a fraction of today's companies will be successful in the decades to come. Those that are will not only follow energy scenario forecasting but will participate in informing the work ahead.

Oil and gas has a meaningful role to play in the energy future, but our analysis indicates that the future will divide into those committed to participate in real decarbonization and those who will be left behind. Adamantine can support your business by refining your analysis of future possibilities and helping you articulate your real decarbonization strategy. Reach out today to explore how your company can take back the reins on its future.

> "Plan for the future, because that is where you are going to spend the rest of your life"
>
> — MARK TWAIN

Endnotes

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