QUANTUM CAPITAL GROUP

2026 Stakeholder Report

Delivering Risk-Adjusted Returns and Investment Stewardship

Information in this report includes the beliefs, opinions, and assessments of Quantum and its personnel with respect to the topics discussed herein, including potential future trends. There can be no assurance that any historical trends will continue.

ESG factors are only some of the many factors Quantum considers in making an investment, and there is no guarantee that Quantum will successfully implement its ESG policies and procedures or that consideration of ESG factors will enhance long-term value and financial returns for limited partners or increase the ESG performance of investments. Descriptions of any ESG achievements or improved practices or outcomes are not necessarily intended to indicate that Quantum has been the sole or primary contributor to such achievements, practices, or outcomes.

Although Quantum views the consideration of ESG to be an opportunity to potentially enhance or protect the performance of an investment over the long-term, Quantum cannot guarantee that its ESG program, which depends in part on qualitative judgments, will positively impact the performance of any investment, and there can be no assurance that the applicable market will view any ESG results as desirable. Additionally, there can be no assurance that Quantum will be able to achieve or continue to achieve any ESG-related objectives or that Quantum's actions will not result in outcomes that could be viewed as having a negative ESG effect. Actual results may be significantly different from the forward-looking statements herein.

Please refer to the Appendices for important additional information and disclosures.

Letter to Stakeholders

"Affordable, reliable energy remains fundamental to prosperity."

Dear Stakeholders,

The global energy landscape remains dynamic and complex, shaped by shifting trade policies, geopolitical tensions, tariff negotiations and sanctions, global supply chain realignment, competition for critical resources, and evolving market forces. These dynamics continue to influence capital flows, commodity pricing, and investment priorities across the energy sector. Navigating this environment requires investors who can manage uncertainty while remaining focused on long-term value creation.

At Quantum Capital Group, we believe our disciplined investment strategy is built for precisely these conditions. We believe we have positioned our portfolio to perform across cycles, allowing us to consistently deliver attractive, risk-adjusted returns for our investors. We also believe this investment environment requires pragmatism, perspective, and precision – and presents an opportunity to apply nearly three decades of experience.

Our work centers on creating long-term value while helping build the energy systems that sustain human progress. That conviction – that abundant, reliable, and clean energy remains fundamental to prosperity – continues to guide how we invest, manage risk, and partner with exceptional teams to help shape the future of global energy.

Energy as the Foundation of Prosperity

Energy remains essential to every facet of modern life. Abundant and reliable energy access supports economic growth, industrial development, and quality of life around the world. Clean, efficient systems ensure that progress is sustainable over time. For Quantum, this interdependence defines the case for an all-of-the-above energy strategy – one that seeks to advance affordable and reliable supply while investing in technologies that can reduce emissions and strengthen resilience.

We believe meaningful progress requires balance – expanding access and reliability while advancing pragmatic pathways to lower emissions. Human welfare depends on both: dependable energy today and cleaner systems over time, pursued together rather than treated as competing priorities.

Navigating Policy and Geopolitical Realities

The current political and economic environment underscores the importance of this balance. Trade disputes, sanctions, and shifting alliances continue to shape global markets. In addition, new policy directions under the Trump administration are expected to influence infrastructure investment, permitting, and domestic energy production. At the same time, heightened geopolitical volatility – from OPEC+ production decisions to evolving U.S.–China relations, and ongoing developments involving Iran and Venezuela – continues to influence supply expectations, sanctions regimes, and global trade flows, creating both challenges and opportunities for energy investors.

These realities reinforce our disciplined focus on capital efficiency, operational strength, and prudent risk management. Our portfolio companies hedge production, manage leverage conservatively, and seek to maintain disciplined cost structures – practices that reduce cash-flow volatility and preserve flexibility across market cycles. This approach allows us to navigate complex conditions while continuing to deliver attractive returns for our investors.

Pragmatic Stewardship and ESG Integration

For Quantum, integrating environmental, social, and governance (ESG) factors has always been part of disciplined investing. When applied thoughtfully, we believe it strengthens risk management, improves efficiency, and uncovers opportunities for growth. Our approach is pragmatic and data-driven – focused on the factors that materially influence performance, value creation, and long-term resilience. By embedding these principles into our investment process, we strive to help portfolio companies operate more efficiently, strengthen governance, and position themselves to meet evolving stakeholder and regulatory expectations. Over time, we believe this approach has proven to be a competitive advantage.

We also recognize that our investors have a diverse set of priorities, from risk-adjusted returns and capital discipline to sustainability and infrastructure growth. We view these objectives as mutually reinforcing under a balanced, fact-based investment framework that values performance and progress together. Through this lens, Quantum continues to advance an energy transition that is realistic, responsible, and durable.

Positioned for Long-Term Growth

Quantum's investment model has been refined over nearly three decades and tested through every phase of the energy cycle. Our portfolio is diversified by sector, geography, and commodity mix, giving us flexibility and perspective across the entire value chain. We believe this breadth allows us to identify opportunities earlier, manage risk more effectively, and serve as a solutions provider rather than simply a source of capital. We continue investing in our team, digital systems, and data capabilities to strengthen that advantage and reinforce our role as disciplined stewards of investor capital.

Looking Ahead

Periods of transition often redefine industries, but they also reaffirm the importance of sound judgment and disciplined execution. We believe the energy sector is entering such a moment – one that will reward investors who remain grounded in fundamentals while pursuing an all-of-the-above strategy that balances reliability, affordability, energy access, and pragmatic progress toward lower emissions.

As global demand continues to expand, the need for scalable, resilient, and economically sustainable energy solutions will only intensify. We see this not simply as a challenge, but as a long-term investment opportunity. At Quantum, we are focused on applying our experience, perspective, and operational expertise to opportunities that strengthen energy systems, support economic growth, and create durable value for our investors. While markets evolve and technologies advance, the principles that have guided us for nearly three decades – sound judgment, disciplined execution, and deep sector knowledge – remain the cornerstone of our success.

Thank you for your continued trust and partnership.

Sincerely,

Wil VanLoh
Founder and CEO

Quantum's Purpose, Vision & Values

At Quantum Capital Group, our purpose, vision, and values are the guiding principles that define our commitment to success and sustainable growth. We believe that by aligning our investments with our core principles, we can create long-term value for our stakeholders and achieve strong financial performance.

Purpose

Quantum's purpose is to advance today's energy ecosystem for tomorrow's sustainable world while seeking to deliver superior risk-adjusted returns to our investors.

Vision

Quantum's vision is to use our capital, expertise, and influence to lead the world in addressing energy security and climate change to improve the lives of current and future generations.

Values

Discipline

We are thorough and thoughtful in our work and decisions, remaining intensely focused on achieving our firm's goals and strategies.

Collaboration

We effectively work together as a team, delivering outcomes that incorporate the best from everyone. We seek solutions that address the needs of all stakeholders.

Integrity

We do the right thing, remaining true to ourselves and our word even when the choice is not easy.

Excellence

We are a high-energy organization that is committed to being the best in whatever we do, always striving for exceptional performance results.

Humility

We understand our place in the world, respecting others and appreciating the value that diversity brings. We willingly acknowledge our mistakes and limitations.

Ownership

We are accountable for our individual results as well as those of our team. We take the initiative to make positive things happen, not waiting for others to act.

Entrepreneurial

We are creative, competitive, flexible, and nimble; willing to risk failure in order to pursue innovative solutions that have exceptional results.

About Quantum Capital Group

Founded in 1998, Quantum Capital Group is a leading investment firm specializing in the global energy ecosystem, including production, energy transition, and decarbonization. Our team has deep experience investing across the energy value chain, allowing us to meet today's biggest energy challenges with discipline and agility.

With decades of industry experience, we seek to leverage our technical proficiency, value-driven investment strategies, and expertise in diverse capital structures in pursuit of delivering strong, risk-adjusted returns. We are entrepreneurs first, with a long-term vision and a collaborative mindset. Through our high-tech and data-driven approach, commitment to ESG, and vast industry expertise, we believe that we are setting the standard for energy excellence.

25%
Current Investment Exposure
Current activity exposure to all wells drilled in the lower 48

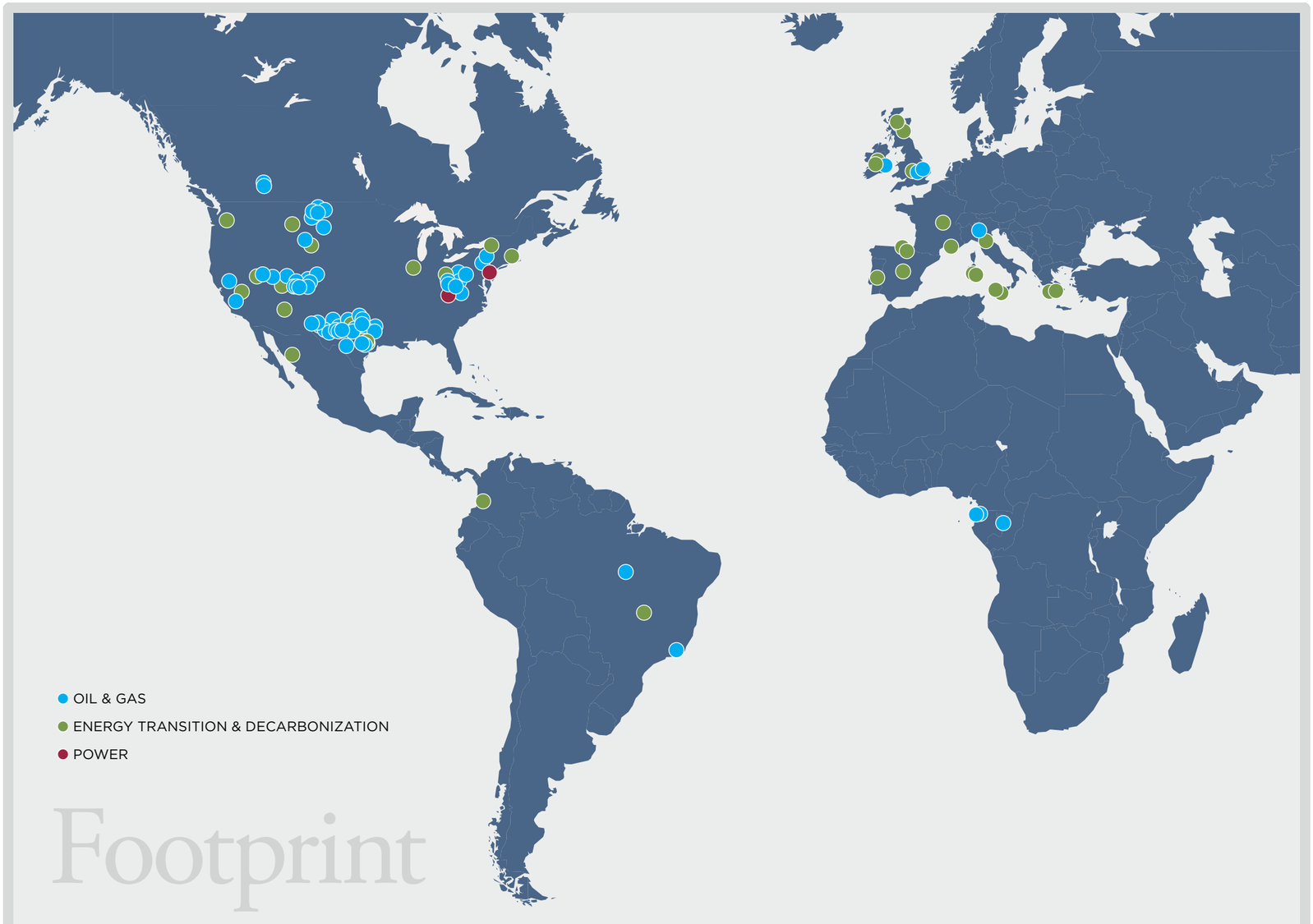
>$4.0 Bn
Drilling CAPEX
Average annual CAPEX spent across all Quantum funds over the past 3 years

>6,000
Wells
Number of wells in which Quantum has had exposure since 2020 across all funds

~620,000 boe/d
Upstream Production
2025 average oil & gas net operated production across all Quantum funds

1.5 Bcf/d
Midstream Throughput
2025 average midstream throughput across all Quantum funds

22 TWh
Electricity Generated
Amount of electricity generated by Cogentrix in 2025, enough to power ~2 million U.S. households[1]



Footprint

[1] Reflects International Energy Agency (IEA) estimate of 10,791 kWh/year for an average U.S. residential utility customer.

Our Investment Platforms and Strategies

About Quantum Capital Group (continued)

1 QUANTUM ENERGY PARTNERS

Private Equity

Quantum's private equity strategy aims to generate competitive, risk-adjusted returns across the global energy ecosystem. Our selective approach enables us to dedicate substantial time and attention to each of our portfolio companies. By leveraging our agility, deep industry knowledge, technical expertise, and robust business acumen, we seek to empower entrepreneurs to break through barriers and rapidly advance their businesses.

2 QUANTUM CAPITAL SOLUTIONS

Structured Capital

Through our structured capital solutions strategy, we seek to provide tailored financing solutions that enable companies in the global energy ecosystem to fund growth projects, build cash flow, and generate shareholder value. Within Quantum Capital Solutions, we focus primarily on investing in public companies via asset-level financing, preferred equity, and structured debt.

3 QUANTUM CREDIT OPPORTUNITIES

Oil and Gas Direct Lending

Within Quantum Credit Opportunities, we focus primarily on providing senior credit to companies in the oil and gas space. We believe our deep technical and operational expertise, structuring experience, and industry relationships make us the partner of choice for companies seeking to optimize their business plans.

SPOTLIGHT

Introducing Quantum Infrastructure Partners (QIP)

Infrastructure

Quantum Infrastructure Partners (QIP) extends Quantum's long-standing investment platform into energy infrastructure, building on decades of experience across the energy value chain. We believe the energy sector is entering a period of sustained infrastructure investment driven by electrification and AI-related demand growth, increased focus on energy security, reshoring of industrial activity, and ongoing decarbonization efforts. Together, these forces are driving the need for new and modernized energy infrastructure assets.

QIP is designed to invest in long-life, real energy infrastructure assets using a value-add and opportunistic approach consistent with Quantum's investment philosophy. The strategy emphasizes advantaged sourcing, active ownership, and disciplined exit planning, with a strong focus on downside protection. QIP will target infrastructure assets with durable demand, high barriers to entry, and stable cash-flow profiles that are less dependent on commodity price movements and well positioned to benefit from long-term structural trends.

"QIP will benefit from what Quantum has learned over nearly three decades – the deep knowledge of the energy space and wisdom garnered from our other investment platforms will position QIP for success."

Dwight Scott,
Executive Vice Chairman

SPOTLIGHT

Quantum's Infrastructure Fund

Interview with Dwight Scott, Ben Daniel, and Rob Meister

"The Quantum Infrastructure Fund is a new fund structure, not a new investment strategy."

Dwight Scott,
Executive Vice Chairman

Q Quantum has built a remarkable track record in hydrocarbon-focused strategies. How would you describe the investment thesis for the Quantum Infrastructure Fund, and how it builds on Quantum's existing platform?

A Over the years, we have committed more than $4 billion to energy infrastructure assets across our existing platforms with strong results. The Quantum Infrastructure Fund builds on that experience by providing a dedicated source of capital to pursue a broader range of more contracted and mature assets. It is a new fund structure, but not a new investment strategy for the firm. We believe the world is in the early stages of an infrastructure super-cycle, particularly in the energy markets where we invest, which will require significant capital. Our approach remains consistent – highly focused on energy, grounded in technical and operational expertise, supported by data-driven decision-making, and guided by a strong risk management mindset.

Q How does this fund expand access for investors and support portfolio diversification?

A Our infrastructure approach is focused on real assets that are critical to the energy industry, with an initial focus on the U.S. These assets – across midstream, power, LNG, and other sectors – can provide attractive risk-adjusted returns and help diversify broad equity portfolios. Their contractual and commercial structures often provide inflation protection to investors, which is particularly important in the current environment.

Q How has your view of energy system resilience evolved, and what do you believe the market is underestimating today?

A Recent events have reinforced the importance of resilient energy infrastructure. While geopolitical tensions, supply chain disruptions, and economic uncertainty continue to affect global markets, reliable energy systems remain essential to economic stability and growth. At the same time, the market often underestimates the capital, infrastructure, and time required to meet rising energy demand. That gap between demand growth and the pace of infrastructure development continues to create both challenges and opportunities for long-term investors.

"We are at the outset of a generational opportunity driven by AI, electrification, and energy security."

Ben Daniel,
Partner

Q How has your experience shaped your vision for Quantum's infrastructure platform, and what differentiates the strategy?

A We believe we are at the outset of a generational opportunity driven by AI, electrification, and energy security, both in the U.S. and globally. Given the complexity of the energy system, success requires more than capital – it requires a deep understanding of physical assets and the industry relationships that underpin them. By leveraging Quantum's energy expertise, technical team, and industry relationships, we believe we are positioning the platform to succeed in this environment. We are also designing the platform to target opportunities often overlooked by larger providers, whose scale constrains their ability to pursue smaller transactions allowing us to invest flexibly across a range of deal sizes.

Q Where on the risk-return spectrum will this fund focus?

A Consistent with Quantum's approach, we believe the most compelling opportunities are in assets where we can add value through active engagement. In energy infrastructure, this can include growth projects, construction execution, and optimization of existing assets. At the same time, we focus on investments with core infrastructure characteristics – long-term contracts, high barriers to entry, and favorable regulatory environments that protect against downside risk. We believe this combination of value creation and infrastructure durability positions us to deliver attractive risk-adjusted returns.

Q Where do you see the most compelling infrastructure opportunities emerging today?

A The most compelling opportunities are emerging across the energy value chain, particularly where rising power demand, electrification, and data center growth intersect with existing infrastructure constraints. Addressing this demand will require continued investment across hydrocarbons, renewables, storage, and enabling infrastructure. The scale of capital required is significant. Multiple industry studies estimate that trillions of dollars will be needed across North America's energy system over the coming decades to meet rising demand. We have designed the platform to invest across this landscape, from gathering and processing to power generation and export infrastructure, allowing us to build a diversified portfolio of high-quality energy infrastructure assets.

Q What is most important to get right early in building this platform?

A While asset selection, structuring, and partnerships are all important, Quantum believes the most critical factor is building a high-quality team that is fully integrated into the broader Quantum organization. We are not building this fund in a silo. By aligning infrastructure expertise with Quantum's existing investment professionals, engineers, data scientists, and operating partners, we can leverage the full capabilities of the firm and position the platform for long-term success.

"If we cannot get comfortable with the downside, we will not invest."

Rob Meister,
Partner

Q How do you approach underwriting infrastructure assets where demand signals are strong, but timing, policy, and technology pathways can shift?

A Quantum's experience across the full energy value chain – upstream, midstream, power, and energy transition – gives us differentiated insight into the signals that drive infrastructure value. We look for long-life, real assets with barriers to entry that generate stable cash flows underpinned by contracts or inherently sticky demand. We aim to underwrite conservatively around what we can observe and verify, stress-testing against market or commodity volatility, regulatory shifts,

SPOTLIGHT CONTINUED

Quantum's Infrastructure Fund

Interview with Dwight Scott, Ben Daniel, and Rob Meister

counterparty credit risk, and technology adoption uncertainty. If we cannot get comfortable with the downside, we will not invest, regardless of how attractive the upside appears.

Engagement with our companies has always been at the core of Quantum's DNA. We are active owners. At Cogentrix Energy, we refinanced the capital structure, implemented programmatic hedging, and identified capacity uprate opportunities across the fleet. At Oryx Midstream, upstream insights helped us identify Delaware Basin infrastructure needs early and build the largest privately held crude midstream operator in the Permian at exit. The common thread is that we bring unique resources, commercial relationships, and operational focus to every investment.

Q What does disciplined infrastructure investing look like in practice?

A Discipline means being willing to let opportunities pass when the risk-return does not meet our threshold. An area of caution for us is when material capital must be committed before key risks – Engineering, Procurement, and Construction (EPC) contracts, permitting, and customer offtake – have been sufficiently de-risked.

The energy sector has many examples where development capital, cost inflation, and regulatory shifts have destroyed value. Those experiences reinforce our commitment to investing in assets that are already generating cash flow or projects that have reached final investment decision with contracted revenues in place. We also aim to avoid paying a premium for "platform value" that has not been demonstrated through actual cash flow generation – we prefer to build value through origination and operations.

Q How does Quantum's data-driven approach translate into better decision-making in infrastructure?

A Our technical and digital teams use proprietary tools that improve the speed, accuracy, and consistency of our evaluations. Our cross-value-chain presence also gives us insights that other infrastructure investors cannot replicate.

In midstream, when we evaluate an opportunity, we can quickly model the production trajectory, assess drilling inventory, and stress-test breakeven points rather than relying on the seller's volume projections. This sort of intelligence drives differentiated insights and outcomes. At Trace, our upstream insights gave us conviction on which areas of the Haynesville had the most economic inventory, directly informing where we placed infrastructure. These tools also allow us to monitor investments more effectively – benchmarking performance, sharing best practices, and identifying value creation opportunities.

Q How has your thinking evolved on what it truly takes to originate and win the best deals in infrastructure?

A Capital is abundant in infrastructure – what differentiates winners is trust and reputation built over time. Nearly 30 years of investing across the energy value chain has given Quantum deep, long-standing relationships with management teams, operators, producers, and intermediaries that compound with every transaction. Our multiple pools of capital – private equity, structured capital, credit, and venture – are also a meaningful source of proprietary infrastructure deal flow. Upstream investments generate midstream opportunities, and structured capital partnerships originate bilaterally from existing relationships. Finally, the depth and breadth of our firm – including investment professionals, technical experts, and shared services across digital, hedging, and procurement – give us a multi-angle view of the market. When our upstream team sees producer activity shifting, our infrastructure team can act early. That collective intelligence allows us to be a solutions provider, not just a capital provider.

Our Team

About Quantum Capital Group (continued)

At Quantum, our people are the foundation of everything we do. We are proud to have built a team of experienced, forward-thinking professionals who bring deep industry knowledge, analytical rigor, and a shared commitment to our clients.

Across all levels of the firm, our team collaborates closely to identify opportunities, manage risk, and drive long-term value creation for our stakeholders – while helping to advance the broader energy ecosystem.

As of 6/24/2026

163 Employees

6 Senior Advisors and Operating Partners

13 member Investment Committee

Multi-Disciplinary Team

We have fully integrated our investment, technical, and strategic shared services teams. We believe this allows us to identify, analyze, price, and manage risk more effectively. Our team's deep expertise allows us to be hands-on, value-added partners to our portfolio companies.

"At Quantum, our 'one team' mindset reflects a deeply held belief that collaboration across disciplines – from investment and technical to ESG and operations – enhances our ability to partner meaningfully with entrepreneurs and portfolio companies. Our culture of shared expertise, respect, and mutual support enables us to meet complex challenges with discipline and agility."

Ajay Khurana,
President

Investment Team

Our investment team is made up of investment professionals, technical experts, and senior advisors who are involved in all aspects of origination, diligence, structuring, portfolio monitoring, and exits.

"At Quantum, investing means partnering with management teams to build strong, resilient businesses. The focus is on disciplined decision-making, operational responsibility, and creating long-term value that benefits investors and stakeholders alike."

Blake Webster,
Partner

Fund Administration and Client Solutions

Our fund administration and client solutions team focuses on compliance, human capital management, and timely reporting to Quantum's limited partners.

"Fund administration and client solutions are built around clear communication and trust. Consistent reporting and operational support help investors understand both financial performance and how ESG priorities are reflected across the portfolio."

Michael Dalton,
Partner & Co-Head of Client Solutions

Technical Team

Our technical team is made up of industry experts that leverage their extensive experience to provide differentiated insights to Quantum's portfolio companies.

"At Quantum, technical rigor guides investment decisions from initial evaluation through execution and ongoing portfolio management. The team brings practical operating experience and data-driven tools to assess assets, anticipate challenges, and support smarter, more confident decisions."

Basak Kurtoglu,
Managing Director & Head of Technical

Strategic Shared Services

Our strategic shared services team supports portfolio companies in areas critical to value creation and risk management, including digital transformation, ESG performance, procurement optimization, marketing, and hedging strategy.

"Our marketing and hedging strategies seek to maximize netbacks and reduce risk on what we can't control, commodity prices, while we focus on what we can control through superior execution."

Garry Tanner,
Partner

"When executed effectively, digital transformations can systemically improve decision-making and elevate a company to the forefront of algorithmic innovation."

Sebastian Gass,
Chief Technology Officer

"At Quantum, ESG is woven into how investments are evaluated and supported over time. Emphasizing environmental responsibility, safety, and strong governance helps ensure long-term value creation for investors and portfolio companies."

Keila Diamond,
Managing Director & Head of ESG

"Our procurement platform helps portfolio companies operate more efficiently by leveraging shared data, structured sourcing tools, and collective scale to lower costs and strengthen supplier performance."

Michael Strathman,
Head of Procurement

SPOTLIGHT

Government Affairs

Interview with Patrick Hughes

Q What are your top priorities as Quantum's government affairs lead, and how do they support Quantum's broader investment and ESG objectives?

A I am privileged to lead Quantum's government affairs practice at such a pivotal moment for the global energy industry. Quantum is among the most active and innovative investors addressing protracted underinvestment and capital constraints in traditional energy while accelerating the path to a secure and reliable energy future.

My top priority is favorably positioning Quantum's portfolio companies in today's constantly evolving and increasingly complex policy environment – in Washington, in the states in which we operate, and in other policy centers around the world. We maintain high-level relationships, strategic engagement, and substantive dialogue with policymakers so that we can proactively mitigate risk and seek opportunities across the Quantum portfolio.

Quantum is well-situated amid the global shift toward energy pragmatism and has a unique opportunity to collaborate with government stakeholders to encourage the policy stability and coordination needed to sustain energy affordability, reliability, and security.

Q How do you work with portfolio companies to navigate evolving regulatory requirements?

A With a combination of factors driving a global recalibration of energy policies and priorities, Quantum's executive leadership team identified the need to develop an in-house government affairs capability. It is the newest of Quantum's shared services offerings, designed to support the exceptional entrepreneurs who build and lead Quantum's portfolio companies.

I engage regularly with portfolio company management teams and their policy, regulatory, and/or government affairs personnel to ensure that I maintain an informed understanding of company-specific priorities and developments that have (or may have) a policy nexus. I think of myself as a natural extension of these teams with a keen interest in their success.

From the Quantum vantage point, I can offer insights, perspectives, and strategic advice on policy matters, facilitate portfolio company dialogue at principal or senior staff levels of government, and help to navigate complex regulatory situations. While I bring the same energy to every situation, no two government-related initiatives are ever identical. I enjoy the unique challenges associated with each opportunity to collaborate with portfolio company colleagues, working together to craft strategies and achieve optimal results.

Q What types of regulatory issues or policy developments are you most actively engaged on today, and why are they particularly important for Quantum?

A There is certainly no shortage of policy issues, trends, and developments to monitor these days. Some are broadly relevant to Quantum while others may present more specific implications for individual portfolio companies.

Rising energy demand forecasts, coupled with economic, manufacturing, and supply chain realities, are driving new concerns over global energy security and the infrastructure development (or maintenance) necessary to deliver the energy the world needs to thrive today and tomorrow.

I regularly engage on an array of macro policy issues ranging from geopolitical events to federal and state permitting reform. It can be quite fulfilling to help portfolio companies connect the dots on seemingly unrelated events around the world – in places like Iran, Russia, Venezuela, and China – to the policy proposals and actions back home that more directly impact their operations.

Tax and tariff policy, environmental deregulation, large-load growth rulemakings, and even political trends and developments can affect Quantum's investment processes, business planning, and execution strategies at the portfolio company level. I also work closely with portfolio companies on a range of regional, state, or basin-specific issues, federal and state permitting initiatives, and community stakeholder campaigns.

Q From your experience, how does early engagement with policymakers and regulators help reduce uncertainty for portfolio companies, especially in areas like permitting, compliance, and reporting?

A I am a firm believer in the importance of maintaining substantive relationships with colleagues in government. As a universal rule, I think elements of familiarity, diligence, and trust bring about dialogue, engagement, collaboration, and productivity. The inverse tends to yield precisely the opposite results.

As many of my Quantum colleagues have heard me say, it is not a very effective government affairs strategy to wait for a situation of acute need to begin a conversation with a government stakeholder. Likewise, and especially when it comes to permitting, compliance, and regulatory reporting, mere periodic (as opposed to regular) contact can result in more volatility and less predictability – manifesting in lengthier review timelines, missed or misunderstood details, and even adverse rulings.

"Quantum is well-situated amid the global shift toward energy pragmatism and has a unique opportunity to collaborate with government stakeholders to encourage the policy stability and coordination needed to sustain energy affordability, reliability, and security."

Patrick Hughes,
Managing Director &
Head of Global Government Affairs

I encourage portfolio companies to approach us early and often, even before they know for sure that they need assistance (i.e. they suspect a need for our support may arise in the future). This allows us to carefully craft a strategy, develop thoughtful narratives, and be deliberate about our engagement with specific government officials.

Q As energy markets, policy frameworks, and ESG expectations continue to evolve, where do you expect your priorities to shift over the next few years?

A I believe Quantum will continue to lead the way in building resilient, successful, environmentally conscious companies that acknowledge the full complexity of global energy systems. While shifts in political power are inevitable and foundational to functioning democracies, energy security and stability are likely to remain universal policy priorities for many years to come.

Whether unleashing the vast energy resources of the U.S., assessing and managing geopolitical risks, promoting efficient permitting and regulation of energy infrastructure, or expanding our international investing and operating activities, I believe Quantum and its portfolio companies will play critical roles in accelerating the path to a secure and reliable energy future.

I am thrilled to be at Quantum at such a fascinating moment in history – both in the U.S. and globally. I look forward to continuing to work closely with our exceptional portfolio companies and contributing to Quantum's unwavering focus on delivering strong, risk-adjusted returns for our investors.

AI and Digital Transformation

AI and digital capabilities are increasingly shaping how investment decisions are made across the energy sector. As data becomes more complex and interconnected, the ability to integrate and apply information effectively is critical. Quantum's focus is on building the data and systems that support more consistent, informed decision-making across its investments.

Quantum's Thesis: Data Scale is the Durable Advantage

Foundation AI models are becoming increasingly accessible. The differentiator is no longer the model itself, but the quality, structure, and usability of the data that informs it.

Quantum has spent decades building not only capital scale, but data scale – across assets, cycles, and real operating outcomes that are not available in public markets. Our proprietary data spans asset-level performance, capital structures, covenants, board and stewardship materials, ESG and safety metrics, and the outcomes of investment decisions.

This dataset forms the foundation for Quantum Firm Intelligence: layering proprietary private-market knowledge on top of advanced AI models to support earlier, more informed decision-making for our investors and portfolio companies.

Public AI models perform well on public information. The greater challenge is connecting internal systems, curating relevant data, and making it usable within AI workflows. In practice, smaller, well-structured datasets consistently outperform larger, unstructured ones. Our continued investment in data quality, governance, and architecture reflects this priority.

From Individual Productivity to Firm-level Intelligence

The shift Quantum is focused on is not from low to high individual productivity. It is from individual-level productivity to firm-level intelligence – where the outputs of AI improve the quality and consistency of decisions across the organization, not just the speed of a single workflow. This requires two capabilities that many AI deployments lack: integration across systems and the application of AI to drive outcomes, not just activity.

The first is a context challenge. Investment decisions in energy private equity are complex, multi-variable, and path-dependent. They draw on well-level production data, commodity price assumptions, capital structure constraints, ESG and regulatory considerations, operator track records, and portfolio-wide exposure simultaneously. Historically, these inputs existed across separate systems – reservoir engineering tools, financial models, portfolio databases, and third-party providers – and the analyst served as the integration layer, manually assembling context before analysis could begin. This creates a low-context starting point for high-stakes decisions.

Quantum's integrated data architecture seeks to address this directly. By consolidating external market data, proprietary petrochemical datasets, financial and operational data from across the portfolio, and firm-generated analytical outputs into a unified, AI-enabled environment, the level of context available at the outset of a decision is significantly increased. An acquisition assessment can simultaneously reference single-well economics, basin-level analog performance from prior investments, current macro assumptions, and portfolio concentration risk – not through a series of manual steps, but as an integrated starting point. The quality of the output is directly linked to the context provided, and this integration makes that context available at decision time.

The second shift is moving from AI as a retrieval and generation tool to AI embedded within defined workflows. Many enterprise AI deployments to date have functioned primarily as search and summarization interfaces: users prompt the system, receive output, and act on it. While this improves individual productivity, it does not fundamentally change how a firm operates.

Quantum is advancing toward workflows where AI supports multi-step processes – querying data sources, running analyses, applying business logic, and producing outputs that feed directly into operational processes.

In practice, this includes systems that monitor portfolio company operating data, identify variance against plan, and surface findings with relevant context. It includes automated stewardship workflows supporting valuation updates, covenant compliance, and reporting without requiring manual data aggregation. It also includes capital allocation tools that evaluate full asset inventories and return optimized development plans based on defined constraints.

The standard for success is not whether a task is completed more quickly, but whether decisions are more informed and applied consistently across the portfolio. These shifts – higher-context decision-making through integration and the application of AI within workflows – depend on the data infrastructure and organizational capabilities Quantum has been building over several years. Quantum believes that foundation is what enables these capabilities today and will continue to shape how they evolve.

"AI and machine learning … is probably the most profound technology that humanity has seen in the last couple hundred years … Those that don't get behind and embrace it fully are going to be out of business in five or 10 years."

Wil VanLoh,
Founder and CEO

Please see the Disclaimers at the end of this report for important additional information regarding AI considerations in our investment practices.

AI and Digital Transformation

The Quantum Energy Cloud

The Quantum Energy Cloud (QEC) is the operational backbone of our digital infrastructure – a cloud-based platform built with Microsoft and Databricks that integrates financial, operational, and market data across the firm and portfolio into a unified, AI-enabled environment.

Firm Operations

QEC supports workflows that previously required significant manual effort, including quarterly valuations, portfolio company reporting, fund performance analysis, waterfall modeling, tax calculations, cash and credit facility management, and LP reporting.

A significant portion of standard inquiries are now automated, improving efficiency, compressing timelines, and allowing investment teams to focus on higher-value work. Integrating these workflows into a single platform has also reduced manual effort across the firm's annual operating cycle.

Enterprise AI at Quantum

Quantum has adopted Claude Enterprise as the firm's generative AI platform, the interface through which Quantum's institutional knowledge becomes more accessible across the organization. This succeeds Quantum IQ (QIQ), our earlier in-house platform, bringing an enterprise-grade capability that improves continuously and reaches every team.

The platform synthesizes the firm's energy data to support complex queries, automate analyses, and streamline workflows. It is built around the processes and decisions that matter most, from investment underwriting to basin operations, giving teams consistent access to shared information rather than relying on siloed expertise. Adoption is supported by a firmwide governance framework and a Champions Network that promote responsible, secure, and effective use across the organization.

Portfolio Company Ecosystem

Portfolio companies can benefit from access to Quantum's digital ecosystem, including cybersecurity standards, enterprise data infrastructure, and AI-enabled tools.

Through shared systems and collaboration forums, including the AI Working Group, portfolio company leadership teams exchange use cases, lessons learned, and best practices. This approach supports faster adoption of digital capabilities and more consistent application across the portfolio.

Please see the Disclaimers at the end of this report for important additional information regarding AI considerations in our investment practices.

"We are building Quantum Firm Intelligence to layer our proprietary private-market knowledge on top of world-class AI models – to deliver earlier, more informed decisions for our investors and portfolio companies. The destination is not a tool that makes one analyst more productive. It is a system that carries institutional memory across deals, assumptions, and operational history, and makes the whole firm smarter with every cycle."

Sebastian Gass,
Chief Technology Officer

Quantum Firm Intelligence

Quantum Firm Intelligence represents the next phase of the firm's data and AI capabilities – focused on improving context, relevance, and decision quality over time.

It combines proprietary private-market data with advanced AI models, allowing those models to operate within the context of Quantum's energy and infrastructure experience in a secure environment.

The objective is not simply to improve individual productivity, but to strengthen how knowledge is retained and applied across the firm – capturing insights from prior investments, assumptions, and operational outcomes to inform future decisions.

Looking Ahead

Digital transformation is not a one-time initiative. It requires sustained investment in data infrastructure, system integration, and practical applications that improve outcomes over time.

Quantum has been building this foundation for several years. As these capabilities continue to mature, the focus remains on applying digital tools in ways that improve decision-making, enhance operational performance, and support long-term value creation.

Basin Planning at QB Energy

Accelerating development through AI

CASE STUDY

	PRIMARY OFFICE	YEAR OF INVESTMENT
QB Energy	**Denver, Colorado**	**2024**
	QB Energy was formed in 2024 following the acquisition of assets in the Piceance Basin. QB Energy is focused on the acquisition, development, and production of clean-burning, affordable natural gas in the Piceance Basin in Western Colorado.	

QB Energy, in partnership with Quantum Capital Group, developed an automated geospatial optimization platform that transforms how field development planning is performed in the complex terrain of the Piceance Basin in western Colorado. The tool reduces planning timelines from weeks to minutes while materially improving land utilization and capital efficiency.

The Challenge

Field development in the Piceance Basin is constrained by complex terrain, federal land restrictions, existing infrastructure, and geologic requirements that dictate well orientation. QB Energy manages more than 400,000 net acres and over 4,000 existing wells, creating a dense and highly constrained operating environment.

Historically, development planning relied on manual workflows. A single engineer would place wells and pads sequentially while accounting for dozens of constraints, requiring approximately three weeks to evaluate a single 20,000-acre scenario. Adjusting assumptions required restarting the process, limiting the ability to test alternatives or optimize outcomes at scale.

As QB Energy pursued a significant growth trajectory, this approach became a bottleneck that limited the organization's ability to iterate, adapt, and optimize. Effective capital deployment required evaluating thousands of potential configurations, not a small number of manually constructed scenarios.

The Solution: Automated Pad Development

QB Energy's operations team and Quantum's data science team developed the Automated Pad Development tool, a cloud-based geospatial optimization platform built on Microsoft Azure. The system encodes engineering and geospatial constraints and applies them across a full-field dataset using optimization algorithms, allowing rapid evaluation of development scenarios at scale.

The platform integrates multiple data layers – including lease boundaries, surface restrictions, infrastructure, terrain, and subsurface characteristics, among others – into a unified model. It then generates candidate well locations and pad configurations and applies optimization algorithms to identify development plans that maximize land utilization while respecting more than 25 constraints simultaneously.

Engineers define key parameters, including spacing, pad size, and slope thresholds, and the system evaluates the full solution space within those inputs. What previously required weeks of manual effort is now completed in approximately 20 minutes. A conversational interface further extends the platform's usability, allowing engineers and business stakeholders to query results, compare scenarios, and explore development tradeoffs in natural language.

Results

The tool has been deployed across 12 areas of interest over nine months and is actively informing QB Energy's development program. The impact on planning efficiency has been significant. Engineers can now evaluate dozens of development scenarios per day instead of one per month, materially improving how the organization tests spacing assumptions, incorporates new geological data, and supports capital allocation decisions.

These improvements have translated into better development outcomes. Land utilization improved from 50% to 85%, recovering acreage that was previously inaccessible due to the complexity of optimizing pad and well placement across constrained terrain. This improvement reflects not a change in the underlying resource, but a significant advancement in the ability to systematically evaluate and develop it.

Ongoing enhancements have also improved cost efficiency and performance. The integration of LiDAR-derived terrain models has reduced average earthwork requirements per pad, lowering construction intensity and associated costs. At the same time, optimization improvements have reduced solve times by 50–65%, further increasing planning throughput and enabling teams to evaluate more opportunities in less time.

3wks ▶ ~20min
Planning time reduced per scenario

50% ▶ 85%
Land utilization improved

~$10billion
Development program, Capital informed

Looking Ahead

QB Energy and Quantum continue to expand the platform's capabilities, including improved terrain modeling, additional optimization techniques, and integration of operational data to refine future planning decisions. While developed for the Piceance Basin, the underlying approach is broadly applicable. In complex operating environments, field development planning can shift from a manual, time-intensive process to a scalable, data-driven capability that improves both efficiency and outcomes.

AI-Powered Leasing at Vickery Energy

Transforming mineral title research through AI

CASE STUDY

	PRIMARY OFFICE	YEAR OF INVESTMENT
VICKERY ENERGY	**Fort Worth, Texas**	**2024**
	Based in Fort Worth, Texas, Vickery is focused on the acquisition and development of oil and gas properties in the Appalachian Basin and other select regions within the U.S.	

Vickery Energy, in partnership with Quantum Capital Group, developed an AI-enabled platform that transforms land title research in complex mineral regions. Applied in Appalachia, the system can reduce research timelines from weeks to hours while improving scalability, cost efficiency, and decision-making across leasing campaigns.

The Challenge

Mineral ownership in Appalachia is highly fragmented and historically complex. Decades of severances, multi-generational heirships, and handwritten records make even a single parcel difficult to evaluate. Vickery Energy operates across large leasing programs in West Virginia, where understanding ownership and lease availability is both time-intensive and resource-constrained.

Traditional workflows rely on landmen and abstractors. Ownership research and lease validation require manual review of deeds, leases, and probate records, often spanning more than a century. A single parcel can take days to fully analyze, while scaling across hundreds of parcels requires significant time, cost, and specialized labor. As leasing programs expand, this approach becomes a bottleneck. Operators must evaluate large volumes of parcels quickly, but traditional processes limit throughput and delay capital deployment decisions.

The Solution: Automated Land Title Research and Ownership Analysis

Vickery Energy and Quantum developed StrataSource AI, a cloud-based platform that automates land title research and ownership analysis. Built on Microsoft Azure, the system applies AI models to ingest, process, and interpret large volumes of unstructured land records.

The platform automates three core workflows: (1) identifying current ownership, (2) assembling chains of title, and (3) extracting lease data. It integrates public records, historical documents, and operational datasets into a unified system, enabling rapid analysis at scale.

Engineers and land professionals define key inputs, and the platform evaluates ownership, lease availability, and contact data across entire portfolios. A built-in validation framework maintains accuracy by identifying low-confidence or complex records – such as handwritten documents or breaks in title chains – and routing them for targeted human review, while allowing processing to continue across the broader dataset. This approach preserves data quality without disrupting overall throughput and enables the system to scale efficiently across large leasing programs.

Results

StrataSource AI has been deployed across active leasing campaigns and is now integrated into Vickery Energy's land workflows. Processing speed improved in a way that fundamentally changes the workflow. Leasing teams can now evaluate hundreds of parcels in parallel, replacing a sequential, labor-intensive process with a scalable system that supports faster decision-making and more efficient capital deployment.

In its largest production run to date, the platform processed 640 parcel IDs, analyzed 9,520 documents, and delivered verified ownership results in approximately 40 *hours*. The same scope of work would have required roughly 40 *business days* using traditional landman workflows. This shift materially improves how quickly teams can assess ownership, confirm lease availability, and move forward on priority parcels.

What previously required weeks of manual research can now be completed in hours, fundamentally changing how the organization approaches grassroots leasing. Teams can quickly assess ownership, lease availability, and contact information across large datasets, allowing them to prioritize opportunities and respond more effectively in competitive environments.

The platform also improves cost efficiency and resource allocation. By automating the most time-intensive components of title research, Vickery reduces reliance on scarce, specialized labor while lowering the cost per evaluated parcel. At the same time, built-in validation workflows maintain accuracy, allowing the team to act on results with confidence.

40 days ▶ 40 hrs

Processing time reduced

640 parcels, 9,520 docs

Scale achieved: Processed in a single run

Manual ▶ Automated

Workflow transformation:
Manual, sequential research ▶ automated, parallel analysis

Looking Ahead

Vickery Energy and Quantum are expanding the platform's capabilities, including full chain-of-title automation and broader integration of lease data and ownership analytics.

While developed for Appalachia, the underlying approach is broadly applicable. In regions with complex mineral ownership, land intelligence can shift from a manual, time-intensive process to a scalable, data-driven capability that improves both speed and accuracy.

Cybersecurity

Cyber threats are evolving rapidly, increasing both the frequency and potential impact of attacks across the energy sector. As threat actors become more coordinated and technologically advanced, Quantum has elevated cybersecurity oversight across both the firm and our portfolio companies.

At the firm level, Quantum operates a structured cybersecurity program anchored in the National Institute of Standards and Technology (NIST) Cybersecurity Framework and independently validated through a biennial audit and attestation by A-LIGN, a recognized third-party assessment organization. The program includes 24/7 Managed Detection and Response (MDR) services, with a mean time to contain threats of less than 15 minutes, annual penetration testing, and continuous vulnerability scanning. Quantum has also expanded its cybersecurity governance to address AI-specific risks, including policies governing employee use of AI tools and controls to protect proprietary data from exposure through public AI models.

Quantum extends these standards across its portfolio through a structured oversight program grounded in the NIST Cybersecurity Framework. Portfolio companies receive practical guidance, training resources, and implementation benchmarks, and are evaluated annually using Quantum's proprietary five-star maturity rating model. The model assesses performance across the five NIST functions, helping management teams understand their current posture, prioritize investments, and track progress over time. Results are reviewed at the board level through Quantum's ongoing portfolio stewardship process.

"As AI reshapes the threat landscape, our cybersecurity program must evolve in parallel – combining proven foundational controls with the intelligence and adaptability to stay ahead of emerging risks. We view this not only as a governance obligation, but as a core commitment to protecting long-term value for our investors and portfolio companies."

William McKenzie,
Chief Information Security Officer

In 2025, Quantum's assessment program produced measurable progress in portfolio cybersecurity maturity. Across 13 completed assessments, 43% of portfolio companies improved their scores, and 45% now meet or exceed a three-star maturity rating within the five-star framework – reflecting meaningful advancement in governance, monitoring, and control effectiveness.

Core Expectations for Portfolio Companies

- **Annual Cybersecurity Assessments**
  Mandatory annual cybersecurity assessments conducted by Quantum for all portfolio companies, supported by a structured remediation schedule to ensure ongoing progress.
- **Phishing Awareness Measures**
  Required external tagging for all emails originating from external or suspicious addresses to alert recipients to potential phishing or scam attempts.
- **Enhanced Security Monitoring***
  Negotiated MDR solution with eSentire for all portfolio companies to strengthen real-time threat detection and response capabilities and give us portfolio-wide visibility.
- **Microsoft Upgrade Requirements***
  Upgrades to Microsoft security licenses to provide enhanced security, compliance, and advanced analytics features.
- **Centralized Security Policy Monitoring***
  Require portfolio companies to share Microsoft Cloud access with Quantum to enable centralized monitoring, alerting, and threat remediation through a consolidated dashboard.

* New for 2026

Firmwide Governance and Accountability

At Quantum, governance begins with a clear understanding of the trust placed in us as fiduciaries. We view stewardship of capital as a responsibility that requires sound judgment, disciplined decision-making, and the highest standards of integrity. Our governance framework emphasizes effective risk management, strong internal controls, and transparency across our investment activities.

Key Policies, Guidelines, and Procedures

Our guiding principles, policies, and procedures help support our commitment to strong governance and ethical business practices. Policies and procedures are reviewed annually to help ensure they remain current, effective, and aligned with evolving regulations, industry standards, and business needs. Certain documents, including Quantum's Employee Handbook and Compliance Policies and Procedures Manual, also require annual compliance certifications.

Annual employee acknowledgment of company policies helps reinforce awareness of key expectations, updates, and responsibilities while supporting a culture of accountability and integrity across the organization. This process also strengthens compliance and audit readiness by documenting that employees have reviewed and understood current policies and procedures.

Committees

Each committee at Quantum plays a critical role in our governance and operational framework. The list of committees below does not imply order of importance or hierarchy; every committee contributes uniquely to the success and integrity of our organization.

"At Quantum, governance is how we translate fiduciary duty into action – through disciplined processes, strong controls, and unwavering integrity."

Charles Baillie,
Partner & Chief Operating Officer

POLICIES AND PROCEDURES	REVIEW CYCLE
Employment Handbook	• Purpose, vision and values • Equal employment opportunity • Non-Harassment Policy (zero tolerance) • Employee assistance program and benefits • Open door policy (access to executives and senior management)
Compliance Policies and Procedures Manual	• Code of Ethics • Conflicts of interest, personal securities, insider trading, gifts and entertainment, outside business activities, political contributions • Anti-money laundering, Foreign Corrupt Practices Act • Portfolio management and allocation, proxy voting, valuations, safeguarding clients' assets, marketing, books, records
ESG Policy	• Engagement with portfolio companies on ESG matters • ESG guiding principles for investments and operations • Integration of material ESG factors into investment decision-making processes
Reporting and Grievance Mechanisms	• Anonymous hotline to report complaints and violations via third-party compliance system • Defined process for investigating complaints, including escalation procedures
Additional policies include Quantum's Incident Response Plan, Disaster Recovery and Business Continuity Plan, and Third-Party Management Plan.	

COMMITTEE	RESPONSIBILITY
Executive Committee	Oversees the organization, manages urgent matters, and shapes policies and strategic direction.
Investment Committee (One for each investment strategy)	Establishes investment and risk management guidelines, makes investment decisions and monitors progress, advises and approves certain investment activities, and aligns decisions with each fund's strategic goals.
Valuation Committee	Reviews and approves the valuation of fund investments, including the inputs/variables used in determining the fair value of investments.
Audit Committee	Oversees financial reporting, ensures the integrity of financial statements, and monitors internal controls and compliance with regulatory standards.
Operating Committee	Manages and mitigates operational risks, ensuring that business processes, systems, and controls are effective, resilient, and aligned with Quantum's strategic objectives.
Conflicts and Investment Allocation Committee	Identifies and manages potential conflicts of interest and oversees the fair and transparent allocation of investment opportunities across Quantum.
Expense Allocation Committee	Oversees the proper distribution of expenses, ensuring that costs are fairly and transparently allocated in alignment with financial policies and objectives.
ESG Committee	Oversees the integration of ESG principles into investment strategies and operations.
Artificial Intelligence Committee	Guides the strategic implementation of AI technologies across operations and investments, evaluates AI-driven investment opportunities, and assesses AI-related risks.

Risk Management

Risk management is fundamental to investment success at Quantum and is a primary driver of how ESG is integrated across our investment lifecycle. Our approach is grounded in the recognition that environmental, social, and governance factors can materially influence asset performance, cash flows, regulatory exposure, and exit outcomes. Identifying and managing these risks early and consistently is essential to protecting capital and generating attractive risk-adjusted returns.

Material ESG risks are evaluated as part of the due diligence and investment decision-making process and are actively managed throughout ownership and stewardship. Quantum applies a defined set of ESG risk factors to assess potential exposures, inform structuring and valuation, and prioritize mitigation efforts. By applying this structured framework, we are better positioned to identify risks that traditional financial analysis may overlook, including climate-related exposures, regulatory and compliance considerations, operational integrity, cybersecurity, government affairs, and digital infrastructure.

Our risk assessment framework is further strengthened by close coordination across portfolio engagement, compliance, digital oversight, and government affairs. Insights from our government affairs team and global energy perspectives analysis – including commodities analysis and policy monitoring – inform how we evaluate regulatory developments, geopolitical shifts, and long-term energy market dynamics. By integrating technical diligence, digital capabilities, and governance expertise into a unified risk lens, Quantum maintains a comprehensive view of evolving exposures across the portfolio.

Quantum's multidisciplinary platform enables us to translate material ESG risk insights into action. Investment, technical, and shared services teams work together to evaluate exposures, support mitigation strategies, and strengthen operational resilience across the portfolio. This coordinated approach is embedded in our ESG risk analysis process.

"We are highly focused on identifying ESG risks during due diligence. In today's rapidly changing regulatory environment, we carefully assess for compliance issues and the financial and environmental risks they could pose to our investments."

Tom Field,
Partner

Quantum Risk Analysis Process

Identify

Identify material and operational risks that could impact investment performance

Analyze

Assess the likelihood and potential severity of identified risks

Price

Reflect risk considerations in valuation, structuring, and capital allocation

Manage

Monitor risks and engage actively with management throughout the investment lifecycle

Please see the Disclaimers at the end of this report for important information regarding ESG considerations in our investment practices.

Global Energy Perspective

Inside this section:

The following section represents Quantum's beliefs, opinions, and assessments with respect to the topics discussed herein, including potential future trends. There can be no assurance that any historical trends will continue.

Changing Paradigms for Solving the Dual Challenge

Why improving the human condition should guide our strategies and actions

The paradigm for addressing the Dual Energy and Climate Challenge has shifted. In many parts of the world, there is growing recognition that reliable energy and economic strength have a far greater impact on human prosperity than reducing emissions alone. For years, Quantum has advocated for and supported this pragmatic approach, emphasizing the need to meet growing energy demand while managing climate risks. We have underscored the essential role of energy in supporting human progress, the inefficiency of excessive capital spending to reduce emissions, and the significant role of energy security in global geopolitics. In this year's Global Energy Perspectives, we further highlight the importance of energy in driving economic growth and human prosperity, focusing on a clear hierarchy of energy needs: abundance, reliability, and cleanliness.

At the heart of the evolving energy narrative is a simple but often overlooked truth: energy enables human prosperity. It is the essential ingredient that drives our modern world. It is the industry that drives every other industry, creating a measurable link between energy access and human development. Since the dawn of the industrial revolution, access to more abundant and reliable energy sources has created a golden era of human progress and prosperity, leading to increased life expectancy, greater quality of life, and unprecedented economic growth.

"Energy has powered the greatest leap in human prosperity since the Industrial Revolution, lifting billions out of poverty and driving every sector of the global economy. This report reflects our commitment to advancing that progress through an 'all-of-the-above' strategy that balances energy abundance, reliability, and cleanliness."

Garry Tanner,
Partner

As access to energy expands and living standards improve, these gains also drive higher energy use. This reality is especially evident as global energy demand continues to rise, particularly in developing economies where population growth and economic mobility are accelerating, alongside increasing power needs from AI and data centers worldwide. Growing non-OECD populations and increasing prosperity are expected to drive long-term growth in global energy consumption – reinforcing the need for practical, inclusive solutions that deliver both energy access and environmental progress.

Against this backdrop, the changing paradigm for solving the Dual Energy and Climate Challenge reflects a broader change in the global energy narrative. For much of the last decade, policy discussions centered almost exclusively on emissions reductions, often downplaying the fundamental role of energy in enabling development, stability, and opportunity. However, recent events – including geopolitical conflict, supply chain disruptions, inflationary pressure, and grid reliability challenges – have revealed the risks associated with pursuing climate goals without equal attention to energy affordability, reliability, and security. Around the world, governments are now moving toward strategies that increase energy supply, diversify energy systems, and reduce energy-related vulnerabilities, rather than relying on narrow or fragmented emissions reduction pathways.

This shift is increasingly reflected in the perspectives of policymakers, investors, and energy experts around the world. Bill Gates has argued that while climate change is a serious challenge, it is not an existential one and that improving human welfare must remain central to climate strategy.[1] Columbia University's Center on Global Energy Policy has similarly emphasized that energy access and human development remain critical considerations alongside decarbonization efforts.[2] This shift towards a more pragmatic energy narrative is being driven not only by

concerns about human prosperity, but by the physical reality of rising global energy demand. U.S. Interior Secretary Doug Burgum recently noted that "there is no energy transition – there is only energy addition," capturing the reality that global demand continues to grow and that new sources must complement – not replace – existing ones.[3] Together, these insights underscore that while reducing emissions matters, it should not be at the expense of access, affordability, or resilience.

At Quantum, we have long recognized that abundant and reliable energy is the key to human prosperity and economic stability. This conviction has shaped our investment philosophy for decades and continues to guide how we deploy capital across technologies, geographies, and market cycles in the energy space. We view the evolving global consensus as a validation of the balanced, data-driven approach we have consistently supported – one that recognizes that real-world progress requires abundant and reliable energy first, followed by steady, economically grounded decarbonization.

As energy systems are scaled to meet rising global demand, we will continue to invest in solutions that deliver abundant, reliable, and progressively cleaner energy. This all-of-the-above approach remains central to our strategy and reflects our belief that energy is fundamental in supporting and improving the human condition now and in the future.

GLOBAL ENERGY POLICIES ARE SHIFTING TOWARD STRATEGIES THAT STRENGTHEN AND DIVERSIFY SYSTEMS

2019–Early 2022
Maximum Climate Ambition
EU Green Deal & Corporate Net-Zero Pledges drove a premature de-emphasis on traditional energy[4][5]

2022
Crisis Point
Russian invasion of Ukraine and global inflation forced governments to prioritize energy availability and affordability over speed of decarbonization[6]

2023
Corporate Retreat Begins
BP and Shell begin scaling back deep production cuts in response to growing energy demand[7]

2024
Political and Policy Reversal
Under the Trump administration, the U.S. pivots to "energy dominance"; Canada drops its consumer carbon tax; EU shifts to promoting nuclear power and gas security[3]

2025
Financial Realism
Major banks abandon or weaken net-zero goals (e.g., Wells Fargo) and delink climate goals from executive pay (e.g., UBS, HSBC), citing unachievable complexity[8]

(1) Bill Gates (2025), "Three Tough Truths About Climate," Gates Notes.
(2) Center on Global Energy Policy at Columbia University SIPA (2023), "Energy Opportunity: A Solutions-Centric Framework to Catalyze Energy for Well-Being, Social Progress and Development"
(3) Stanford Graduate School of Business (2025), "Doug Burgum: Forget Energy Transition. Think Energy Addition."
(4) European Commission (2019), "The European Green Deal."
(5) IEA (2021), Net Zero by 2050: A Roadmap for the Global Energy Sector.
(6) IEA (2024), World Energy Outlook 2024.
(7) Reuters (2023), "BP Makes Record Profit in 2022, Slows Shift from Oil."
(8) Reuters (2025), "HSBC Ditches 2030 Net-Zero Emissions Target."

PILLAR 1

Energy Abundance – Access and Affordability

Access and affordability are critical to meet growing energy demand

Energy abundance – defined as broad access to affordable energy – is what makes modern life possible. From the food we eat to the homes we live in, nearly every aspect of daily life depends on energy. It powers industries that manufacture essential goods – from life-saving medicines to the materials that build modern infrastructure – and supports the water systems, hospitals, schools, transportation networks, and digital infrastructure that underpin economic growth and societal well-being. Access means energy is available when and where it is needed. Affordability means households, industries, and governments can pay for energy at scale. Because energy underpins every sector of the economy, both access and affordability shape living standards, productivity, and global competitiveness.

Today, a range of structural and emerging forces are converging to put both energy access and affordability at risk. Global energy demand has risen consistently over time with a growing population and expanding middle class – especially across the developing world. Since 2010, global primary energy demand has increased by approximately 22%, while consumption of all major energy sources has risen in absolute terms despite rapid growth in renewable energy.[1] In fact, global consumption of coal, oil, and natural gas remains near historic highs, with continued growth in overall energy demand expected for the foreseeable future. Additional demand is being driven by the rapid electrification of transportation, buildings, and industrial processes, alongside the accelerating expansion of AI and data centers worldwide. Together, these trends are expected to increase demand across multiple forms of energy, reinforcing the need for reliable, affordable, and resilient supply.[2]

AI and Data Centers: The rapid adoption of cloud services and resource-intensive AI models is creating a significant and highly concentrated surge in electricity demand. U.S. electricity demand is projected to grow at an above-trend rate of 2.3% in 2025 and 2.2% in 2026 – more than double the average annual growth rate over the past decade.[3] AI is a key contributor: according to IEA estimates, a typical AI-focused data center consumes as much electricity as 100,000 households, and the largest centers under construction today will consume up to 20 times more.[2] Bain & Company projects that U.S. data centers alone will consume an estimated 9% of the nation's total electricity demand by 2030.[4]

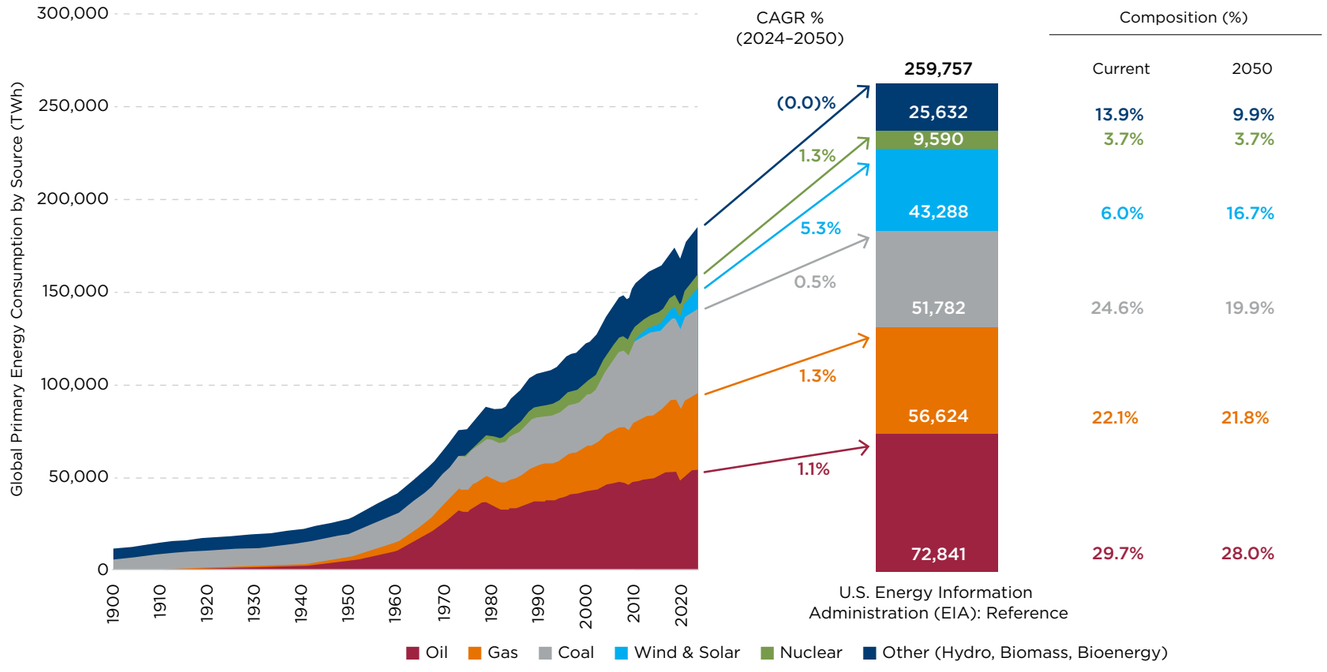
Electrification of Vehicles (EVs): The global shift to electric transportation adds a massive and distributed load to electricity systems. China, where electric vehicles accounted for more than 1% of total electricity demand for the first time in 2024, remained the world's largest EV market, with more than 5 million EVs sold in the first half of 2025.[6][7] In the U.S., EV sales grew 10% year-over-year in the first quarter. While this load is geographically distributed, rising demand places increasing pressure on grid stability, particularly during peak evening charging periods.[8]

These forces are pushing overall energy consumption higher in both emerging and developed markets. Global electricity demand rose by 4.3% in 2024 and is forecast to grow at close to 4% through 2027, compared to an average growth rate of 2.7% over the past decade.[3][5] According to the IEA, total energy demand is expected to grow by approximately 50% between now and 2050. This outlook may prove conservative as the world enters a new "Age of Electricity" – where AI, electrification, and digital infrastructure multiply demand across every sector.[9]

We believe meeting this growing demand while maintaining affordability and access requires energy abundance: resilient and scalable systems that draw on all available energy sources, backed by infrastructure investments and policy frameworks that prioritize energy security, cost stability, and long-term growth. Every region is approaching this challenge through the lens of its own unique resource base, technology access, financial capacity, and regulatory environment – but the need is universal. Energy access and affordability are critical to meet the world's growing energy demand.

HISTORIC GLOBAL ENERGY CONSUMPTION[10]

PROJECTED GLOBAL ENERGY CONSUMPTION



No previous energy transition has ever replaced existing forms of energy – we use more of all forms of energy today on an absolute basis than at any time in history.

(1) Energy Institute (2024), Statistical Review of World Energy 2024.
(2) IEA (2025), Energy and AI.
(3) IEA (2025), Electricity 2025.
(4) Bain & Company (2024), "US Data Centers Are Emerging as a Major Power Consumer."
(5) IEA (2025), Global Energy Review 2025.
(6) IEA (2025), Global EV Outlook 2025: Outlook for Energy Demand.
(7) International Council on Clean Transportation (2025), Global Electric Vehicle Market Monitor for Light-Duty Vehicles: 2025 H1.
(8) Cox Automotive (2025), "U.S. Electric Vehicle Sales Increase More Than 10% Year Over Year in Q1."
(9) IEA (2024), World Energy Outlook 2024.
(10) Vaclav Smil, Our World in Data. EIA (2024) International Energy Outlook (most recent publication).

PILLAR 1

Energy Access

The foundation of human progress and global development

Energy is the fundamental bedrock upon which modern civilization is built, directly underpinning human development and global economic growth. It enables advancements in education, healthcare, and technology, while strengthening national competitiveness and security. Simply put, access to energy provides people with better lives. Without it, people fall into energy poverty, which impacts health, opportunity, and economic stability.

One measure of quality of life, the United Nations Human Development Index (HDI), combines life expectancy at birth, years of education, and per capita income. It serves as a proxy for the human condition. There is a strong correlation between energy consumption per capita and HDI scores. Countries in the developed world generally have higher HDI scores and higher energy use than those in the developing world. To improve the human condition for the world's poorest and fastest-growing populations, these countries need access to affordable, reliable energy. China and India illustrate this connection well. Both have seen significant improvements in HDI scores alongside rapid growth in energy consumption – developments that have strengthened their positions as leading global economies.[1]

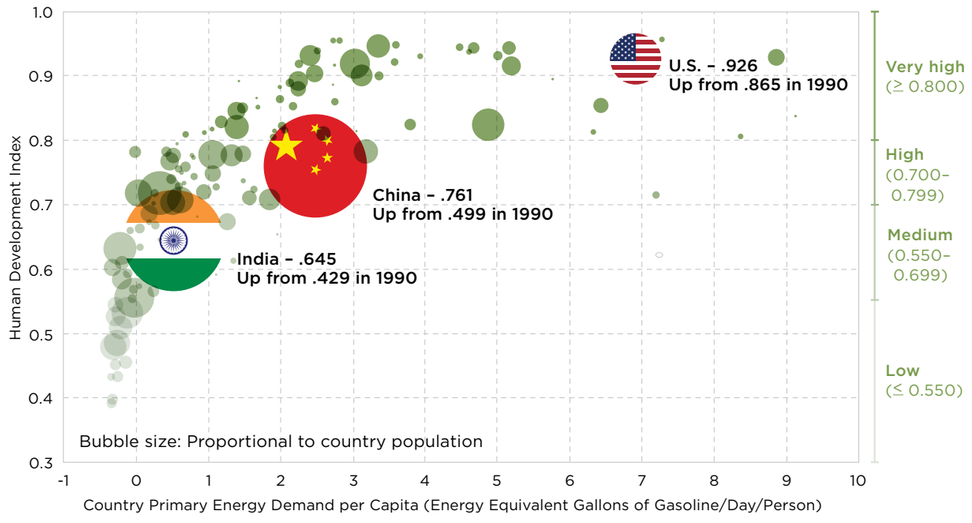
Lack of Energy Access and Energy Poverty

Access to modern energy underpins nearly every dimension of human progress – from education and healthcare to clean water and economic growth. Yet today, about 730 million people worldwide still live without access to electricity – the vast majority in Sub-Saharan Africa and South Asia. Even more striking, roughly 2.3 billion people, nearly one-third of the global population, still rely on traditional biomass such as wood, charcoal, agricultural residues, and animal dung for cooking and heating.[2] These fuels are typically burned in open fires or inefficient stoves, releasing harmful smoke and black carbon.

The consequences for human health and opportunity are profound. The World Health Organization estimates that household air pollution from these traditional fuels causes approximately 3.2 million premature deaths each year, including more than 230,000 deaths among children under five who die from respiratory infections.[3] Women and girls are disproportionately affected, as they spend the most time near cooking fires and often walk hours each day to collect fuel. This burden limits their ability to attend school, earn income, or participate fully in their communities, perpetuating cycles of poverty, as detailed in reports from the World Bank and UN Women.[4]

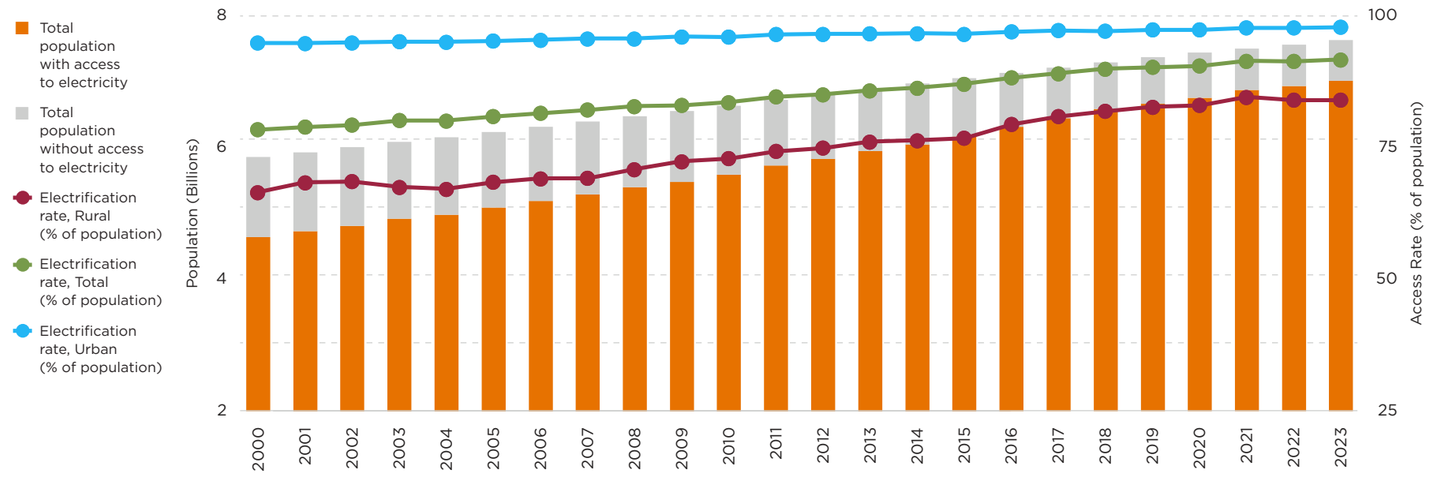
Energy poverty also constrains growth and resilience. Without electricity, clinics cannot store vaccines, students cannot study after dark, and small businesses cannot thrive. Expanding energy access is therefore a moral and developmental imperative that is becoming increasingly urgent as population growth and economic mobility accelerate across the developing world. While progress is being made, the International Energy Agency projects that at the current rate, nearly 2 billion people will still lack access to clean cooking options by 2030.[1] Closing this gap will require sustained investment, innovation, and policies that place human well-being at the center of the global energy transition.

ACCESS TO AFFORDABLE ENERGY IS ESSENTIAL FOR HUMAN DEVELOPMENT IMPROVEMENT[1]



PROGRESS IN ELECTRICITY ACCESS – 2000-2023[5]

Billions of people and share of population with access to electricity



(1) Our World in Data (2024), "Human Development Index vs. Energy Use per Capita."
(2) IEA (2024), World Energy Outlook 2024.
(3) World Health Organization (2024), "Household Air Pollution."
(4) UN Women (2024), "Gender, Energy and Sustainable Development."
(5) World Bank (2024), Tracking SDG 7: The Energy Progress Report.

PILLAR 1

Energy Affordability

Why energy prices shape economic stability, growth, and opportunity

Energy affordability is shaped by both cost and price stability – and by how these factors influence households, industries, and governments. It is not determined solely by the cost of producing energy, but by the entire journey from resource to end use. Factors such as production costs, financing conditions, infrastructure, distribution networks, energy-mix diversity, tax regime, and the geopolitical environment all influence the prices that consumers ultimately pay for power, fuel, and heat, as well as the volatility of those prices over time.

The 2022 global energy crisis revealed how interconnected and fragile this journey can be. When Russian natural gas supplies to Europe were disrupted by the invasion of Ukraine, countries with limited fuel supply and diversity experienced extreme price spikes and volatility, with significant negative economic and social consequences. By contrast, regions with more diversified energy systems – including renewables, nuclear, and domestic fossil fuels – proved more resilient, reinforcing the link between energy-system design, price stability, and economic security.

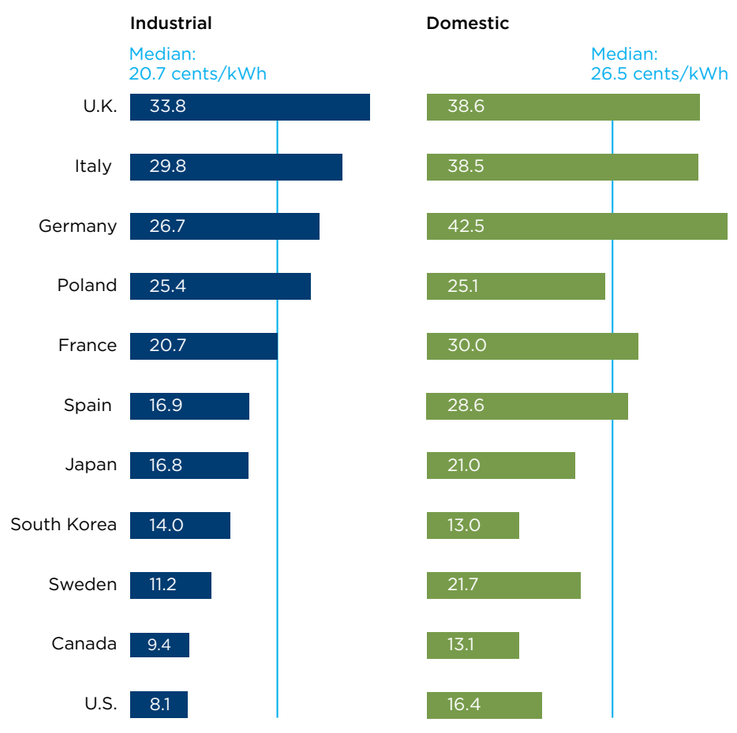
More broadly, recent experience has shown that energy prices are shaped not only by the share of any single technology, but by how well the overall system is designed to deliver reliable energy at scale. In some markets, rapid renewable deployment without sufficient investment in grid infrastructure, storage, and dispatchable backup has coincided with higher electricity costs and system inefficiencies. Many European countries with high renewable penetration have experienced elevated residential power prices, highlighting how affordability ultimately depends on integration, flexibility, and system balance. Stable, affordable energy prices are critical to economic growth and opportunity – supporting household budgets, industrial competitiveness, and long-term investment across the broader economy.[1]

Affordability at the Industrial Level

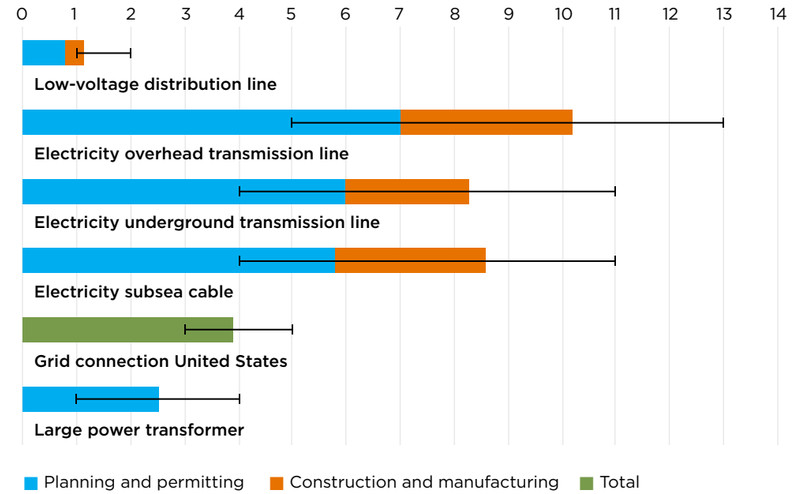
At the industrial level, energy affordability is a core determinant of competitiveness, investment, and growth. Energy costs influence where capital is deployed, which industries expand, and whether manufacturing, processing, and energy-intensive activities remain viable over the long term. In both developing and advanced economies, sustained high energy prices or unreliable supply can compress margins, erode global competitiveness, and slow industrial growth – ultimately limiting job creation and economic opportunity.

Price stability is equally critical. When energy costs are volatile or unpredictable, businesses face uncertainty around a fundamental input, making it more difficult to plan, finance, and justify long-lived capital investments. Over time, persistent price volatility can delay or divert investment, discourage new capacity, and weaken confidence across supply chains. The result is not only slower industrial development, but broader economic drag, as higher energy costs ripple through production, logistics, and consumer prices across the economy.

ELECTRICITY PRICES IN SELECT COUNTRIES – 2024[2]
(cents/kWh)



AVERAGE LEAD TIMES TO BUILD NEW ELECTRICITY ASSETS IN EUROPE AND THE U.S. – 2010-2021[3]



Why Energy Diversity Matters for Affordability

The 2022 global energy shock demonstrated that countries with more diversified energy systems generally experienced less price volatility than those reliant on one or two primary sources. While estimates vary across studies, the directional conclusion is consistent: diversity within national energy systems acts as a practical hedge against supply disruptions and a critical driver of price stability.

Energy diversity operates across multiple dimensions, including:

- **Fuel types** – balancing variable sources like solar and wind with dispatchable sources like gas, hydro, and nuclear.
- **Geographic supply routes and counterparties** – reducing overreliance on a single exporting nation or region.
- **Storage and demand-shifting technologies** – allowing surplus energy to be saved and deployed when needed.
- **Infrastructure interconnections** – enabling regional cooperation and grid flexibility.

No single element determines affordability. Together, however, these attributes reduce exposure to price shocks, improve system reliability, and lower long-term costs for households and industry alike. Countries that invest in diversified energy pathways are better positioned to sustain economic growth, attract capital, and absorb future disruptions. Ultimately, affordability – like access – is a foundational element of energy abundance.

(1) IEA (2024), World Energy Outlook 2024.
(2) Wall Street Journal, using data from IEA, EIA, Energy Institute Statistical Review of World Energy 2025, and Our World in Data population analysis based on various sources (2024), accessed May 2026.
(3) IEA (last updated January 2023).

PILLAR 1

U.S. Shale Boom Impacted Worldwide Supply & Geopolitics

Over the last 15 years the U.S. has shaped worldwide energy prices and access

CASE STUDY

Over the past 15 years, the U.S. has demonstrated how energy abundance – enabled by rapid supply growth, technological innovation, and a diversified energy mix – can reinforce both affordability and access. The U.S. shale boom fundamentally altered the trajectory of global oil and natural gas supply, driving a majority of the world's energy growth and making the U.S. the world's largest producer of liquid fuels and natural gas. This has improved affordability, enhanced energy security, and reduced the world's exposure to concentrated supply shocks.

At the center of this transformation was the expansion of shale oil and natural gas production. Beginning in the late 2000s, advances in horizontal drilling and hydraulic fracturing unlocked vast domestic resources at scale. U.S. crude oil production more than doubled – from approximately 5 MMbbl/d in 2008 to over 13 MMbbl/d – while natural gas production increased from roughly 50 Bcf/d to more than 100 Bcf/d, and NGL production quadrupled, rising from approximately 2 MMbbl/d to more than 7 MMbbl/d during the same period. This surge was unprecedented in both speed and magnitude, representing one of the largest supply expansions in modern history.[1]

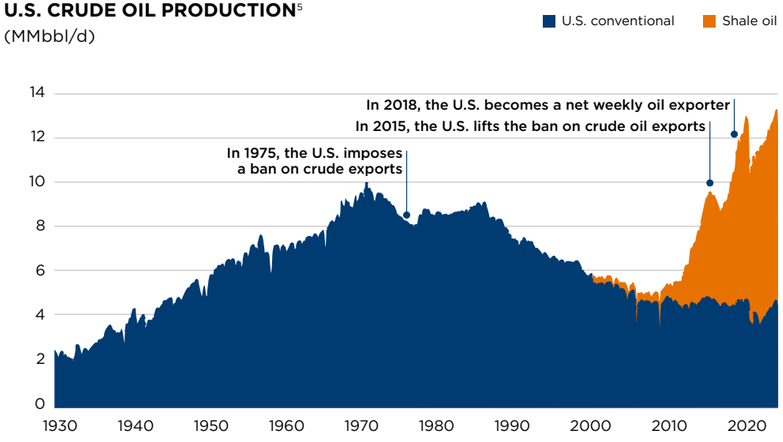
The global implications were significant. According to the IEA, the U.S. has accounted for the vast majority of non-OPEC oil supply growth over the past decade and is expected to contribute a substantial share of incremental global supply through the remainder of the decade. In aggregate, U.S. production growth has represented approximately 100% of global oil supply growth, 73% of global NGL supply growth, and 54% of global natural gas supply growth, fundamentally reshaping global energy markets and reducing the pricing power of traditional exporters.[2]

This expansion also transformed the U.S. into a leading global energy supplier. The U.S. became the world's largest producer of oil and natural gas and, more recently, the largest exporter of LNG. LNG exports grew from effectively zero in the mid-2010s to more than 15 Bcf/d and are projected to exceed 30 Bcf/d by 2030, enabling the U.S. to supply critical volumes to Europe and Asia – particularly during periods of disruption such as the 2022 energy crisis and the current Middle Eastern conflict. The availability of flexible U.S. LNG has become a cornerstone of global energy security, helping countries diversify supply and reduce dependence on single-source or more unreliable providers.

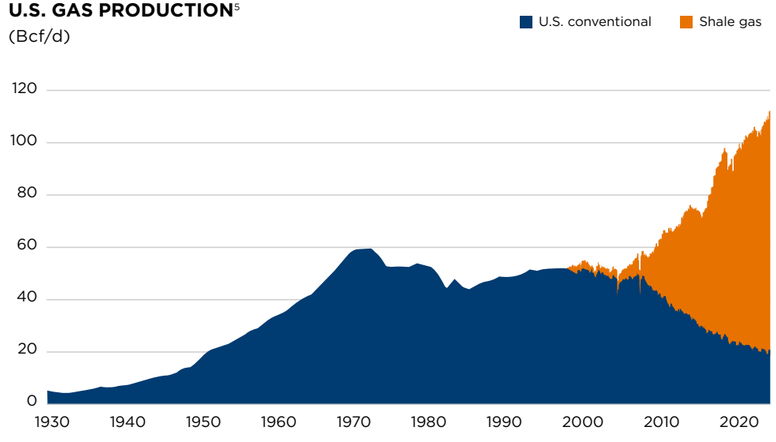
The affordability impacts of this supply growth were substantial. Increased U.S. production contributed to a structurally lower and more stable global oil price environment than would have otherwise prevailed, while domestic natural gas prices remained among the lowest in the world. Over the last 15 years, U.S. natural gas prices averaged approximately $3–4/MMBtu, compared to approximately $8–12/MMBtu in Europe and $10–14/MMBtu in Asia over the same period.[3] This cost advantage supported the expansion of energy-intensive industries – including chemicals, fertilizers, steel, and manufacturing – while also enabling the rapid growth of data centers and digital infrastructure. For consumers, abundant supply helped moderate electricity and heating costs and insulated households from the extreme volatility experienced in more import-dependent regions.

At the same time, the U.S. energy system maintained flexibility through a diverse mix of resources. Natural gas played a critical role as a dispatchable, scalable fuel that supported reliability while enabling the integration of renewable energy. As wind and solar capacity expanded, gas-fired generation provided the balancing capability needed to manage intermittency, meet peak demand, and maintain grid stability. This combination of abundant supply and system flexibility allowed the U.S. to expand access, improve affordability, and reduce emissions through coal-to-gas switching – demonstrating that traditional and emerging energy sources can work in tandem.[4]

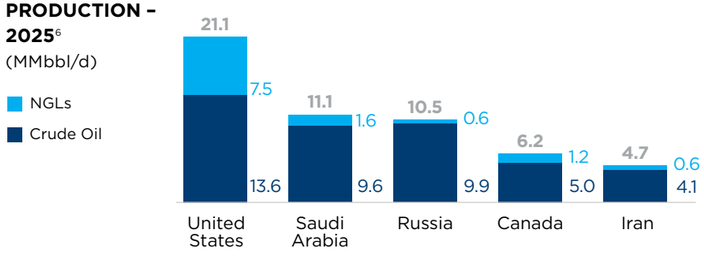
U.S. CRUDE OIL PRODUCTION[5]
(MMbbl/d)



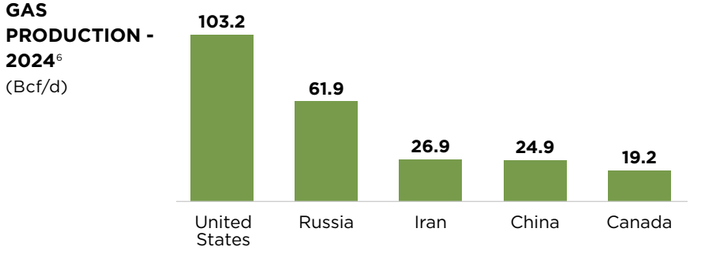
U.S. GAS PRODUCTION[5]
(Bcf/d)



LIQUIDS PRODUCTION – 2025[6]
(MMbbl/d)



GAS PRODUCTION - 2024[6]
(Bcf/d)



(1) EIA (2025), Annual Energy Outlook 2025.
(2) IEA (2024), World Energy Outlook 2024.
(3) EIA (2025), Henry Hub pricing data; European TTF benchmark pricing; and JKM LNG benchmark pricing.
(4) IEA (2023), The Role of Gas in Today's Energy Transitions.
(5) EIA (2026), U.S. Natural Gas Monthly Supply and Disposition Balance; and Enverus.
(6) Energy Institute (2025), Statistical Review of World Energy 2025.

PILLAR 1

Infrastructure Constraints Impact Access and Affordability

Why significant resources are not enough without infrastructure to deliver energy where it is needed

CASE STUDY

Energy access and affordability are ultimately determined not by how many energy resources a region has or can produce, but by whether that energy can be delivered reliably and efficiently to where it is needed. North America offers numerous examples of how infrastructure constraints can impact both energy access and affordability.

Significant Gas Differentials Due to Infrastructure Constraints

The U.S. and Canada are home to some of the world's most prolific natural gas basins. Despite these vast resources, insufficient pipeline infrastructure can still drive significant price volatility, with regional prices rising or falling sharply depending on whether markets are undersupplied or oversupplied. Montney and Duvernay formations in Western Canada can produce large volumes of relatively low-cost gas. However, insufficient pipeline takeaway capacity – often limited by regulatory and permitting hurdles – has constrained the ability to move supply to demand centers. As a result, prices at the production hub have frequently traded at significant discounts relative to broader market benchmarks.[1] The chart below illustrates these regional gas price differentials, which tend to widen during periods when available pipeline capacity is constrained, at times falling below negative $2/MMBtu in Canada.

The U.S. Permian basin is another example of how pipeline constraints can materially affect regional gas price differentials. Because natural gas is produced alongside oil as associated gas, limited takeaway capacity can restrict the ability to move supply out of the basin. The chart below illustrates the relationship between pipeline egress constraints and regional gas price differentials. At times of severe constraint, producers have even accepted negative gas prices – effectively paying pipeline operators to take the gas – because the value of oil production outweighs the cost of disposing of associated gas.[2]

In other regions, including the Western U.S., pipeline development has slowed due to regulatory and permitting pressures. During periods of high winter demand, these constraints can leave available supply insufficient to meet regional needs, contributing to meaningful spikes in natural gas prices. Conversely, during warmer winters, Canadian gas differentials can widen sharply due to weaker regional demand and limited infrastructure flexibility.[3]

In each of these scenarios, regional price differentials are driven less by geology or technology than by infrastructure limitations that restrict the efficient movement of energy supply. This disconnect illustrates how abundant energy resources at the national level do not always translate into regional access or affordability.

Long Timelines are an Issue

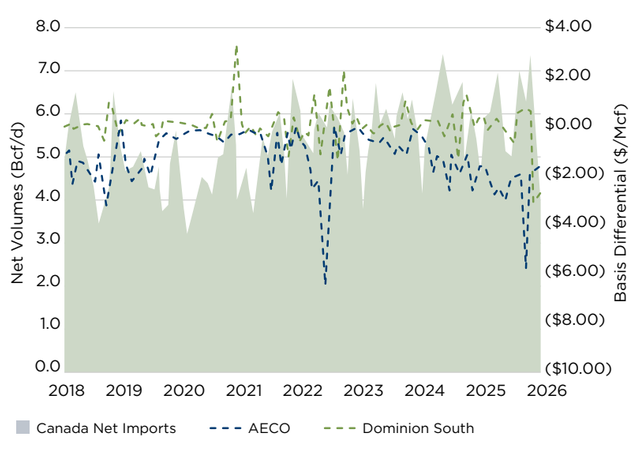
Major energy infrastructure takes time to develop, and long timelines remain a structural challenge. A long-distance transmission line can take close to a decade from initial planning to commissioning. Gas pipelines, storage facilities, and LNG export terminals can face similarly extended development horizons. Regulatory approvals, environmental permitting, right-of-way negotiations, equipment lead times, and the availability of skilled labor all add complexity and possible delays, often compounding over time.[4] Left unaddressed, today's permitting backlogs and infrastructure shortfalls become tomorrow's affordability challenges. Delays constrain supply, limit system flexibility, and increase exposure to price volatility.

There are, however, early signs of progress. In the U.S., regulatory reforms are encouraging grid operators to plan further ahead and allocate interconnection costs more transparently. Environmental review processes are being streamlined to reduce duplication while maintaining safeguards. In Canada, a renewed focus on economic growth and improved coordination between federal and provincial authorities is helping advance projects with greater clarity and accountability.[5]

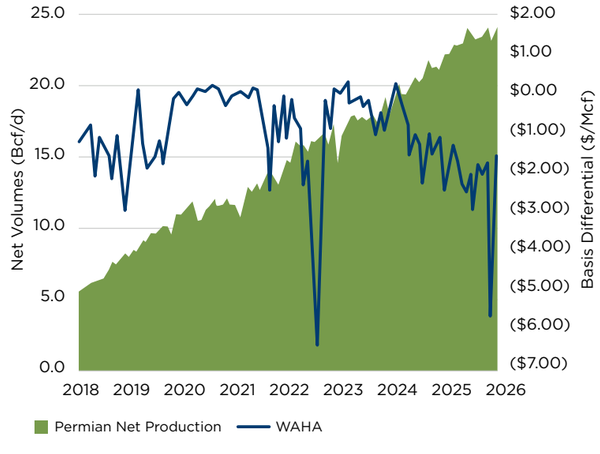
The takeaway is clear: affordable energy requires more than low-cost supply. It requires the infrastructure needed to connect supply to demand reliably and efficiently. Pipelines, interconnections, and storage are not optional – they are prerequisites for translating resource abundance into real-world energy access and affordability.

(1) EIA (2024), "Appalachian Natural Gas Pipeline Constraints and Regional Price Differentials."
(2) RBN Energy (2024), "Permian Associated Gas and Pipeline Constraints."
(3) Federal Energy Regulatory Commission (2024), "Winter Energy Market and Reliability Assessment."
(4) IEA (2023), Electricity Grids and Secure Energy Transitions.
(5) IEA (2024), World Energy Outlook 2024.
(6) EIA, Canadian natural gas trade and pricing data, and Enverus, accessed May 2026.
(7) EIA, Permian natural gas production data, and Enverus, accessed May 2026.
(8) Bloomberg and Enverus, U.S. regional natural gas pricing data, accessed May 2026.

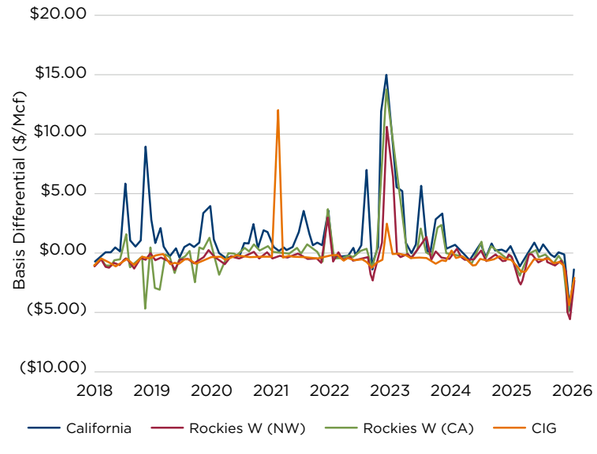
CANADA: PRODUCTION, IMPORTS, AND PRICING[6]



PERMIAN: GAS PRODUCTION WITH DIFFERENTIAL[7]



U.S.: WESTERN GAS PRICE DIFFERENTIALS AT VARIOUS GAS HUBS[8]



PILLAR 1

California's Energy Transition Tradeoffs

Affordability and the cost of constrained domestic production

CASE STUDY

California spent the last two decades pursuing the most famously aggressive decarbonization and anti-domestic energy agenda in the U.S., while steadily reducing in-state oil production and refining capacity. Energy demand has not diminished, however, and Californians still consume roughly 1.4 million barrels per day of petroleum products.[1] These policies have reduced domestic production, increased imports, and caused energy prices to rise across the state.

As local production declined and reliance on imported energy increased, consumers absorbed the higher costs associated with a tighter and less flexible fuel supply. California gasoline prices consistently rank among the highest in the U.S. and have periodically exceeded the national average by more than $1.50 per gallon.[2] Since 2004, in-state production has declined from approximately 656 thousand barrels per day to 300 thousand barrels per day, while foreign imports increased from roughly 38% to 65% of total crude supply.[1] Refinery closures and increasingly tight fuel specifications also reduced supply flexibility, leaving the state more exposed to outages, maintenance events, and broader global supply disruptions.

California's Growing Import Dependence

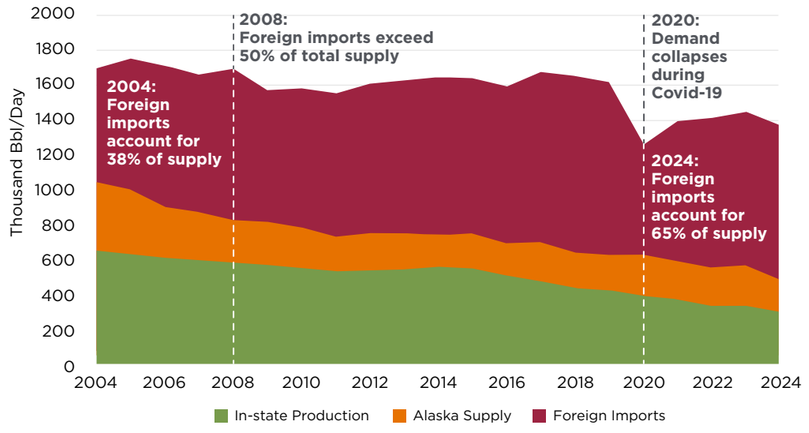
California's declining in-state oil production increasingly shifted the state toward imported crude and refined products. As refineries were shut down or converted to produce renewable fuels, California became increasingly reliant on imported transportation fuels. At the same time, reduced refining capacity and pipelines concentrated more of the state's fuel supply within a smaller number of facilities and supply channels. This reduced redundancy and left California more sensitive to operational disruptions and external market shocks, highlighting the tradeoffs associated with shrinking local energy infrastructure while maintaining substantial energy demand.

Energy Affordability and Consumer Costs

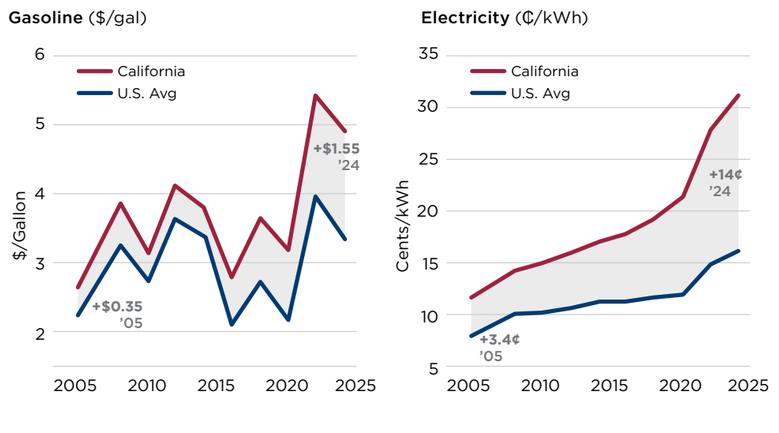
Consumers increasingly absorbed the cost of tightening supply conditions and higher regulatory complexity. California gasoline prices consistently traded well above the U.S. average, while residential electricity prices rose from roughly 13¢/kWh in 2005 to more than 31¢/kWh by 2024 – approximately 14¢/kWh above the national average.[2] By 2025, households and businesses in California – the most populous state in the U.S., representing 12% of the nation's population – were paying some of the highest retail energy prices in the country. Despite remaining one of the largest energy-consuming economies in the U.S., California has increasingly relied on imported energy rather than expanding more affordable in-state production.

At the same time, emissions reductions progressed more gradually than many policymakers originally envisioned. Despite California's ambitious decarbonization goals and broader energy transition efforts, overall emissions reductions remained relatively modest compared to the scale of economic and regulatory changes implemented. Additionally, these emissions reductions are only measuring state reductions and not accounting for the significant worldwide emissions caused by foreign producers of the imported energy. California's experience illustrates that energy transitions are not solely environmental exercises. They also involve affordability, infrastructure, reliability, and supply security.

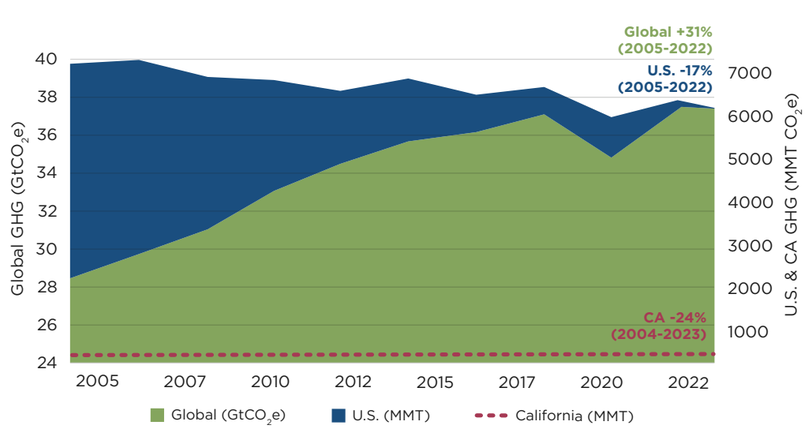
CALIFORNIA OIL DEMAND, IN-STATE PRODUCTION, AND IMPORT SOURCES – 2004-2024[3]



CALIFORNIA VS. U.S. AVERAGE GASOLINE AND ELECTRICITY PRICES – 2005-2025[4]



GHG EMISSIONS: GLOBAL, U.S., AND CALIFORNIA – 2005-2022[5]



(1) EIA, California Crude Oil Production; California Energy Commission (CEC); California Geologic Energy Management Division (CalGEM).
(2) EIA, Electric Power Monthly; AAA Gas Prices; California Public Utilities Commission (CPUC) Residential Electric Rates.
(3) IEA (2024), CO_2 Emissions 2023; EPA (2025), Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2023; CARB (2025), California Greenhouse Gas Emissions for 2000–2023.
(4) EIA (2025), Petroleum Marketing Monthly; EIA (2025), Electric Power Monthly, Table 5.6.A; CPUC (2025), California Electric Rates and Energy Policy Data.
(5) CO_2 Emissions Database (2023); Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2023 (2025); California Greenhouse Gas Emissions Inventory: 2000–2023 (2025).

PILLAR 2

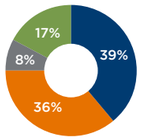
Energy Reliability – Security and Resilience

A resilient and secure energy system supports regional prosperity

Energy reliability means energy is available when and where it is needed – even in the face of challenging situations like adverse weather, system failures, or unexpected shocks. It is shaped by two closely related dimensions: energy resilience and energy security. Energy resilience refers to the ability of an energy system to respond to and recover from disruptions. Energy security reflects the degree of control a country or region has over its energy supply, whether through domestic resources, strategic reserves, or diversified import routes.

In practice, security and reliability are not achieved through a single fuel or technology, but through the interaction of resource availability, infrastructure, and system design. Across global energy systems, energy mixes reflect these underlying constraints and priorities – balancing affordability, access, and reliability based on local resource endowment and geopolitical realities. Regions with abundant domestic resources and integrated infrastructure tend to exhibit greater resilience, while those reliant on imports or weather-dependent generation must rely more heavily on diversification, storage, and system flexibility to maintain reliability.

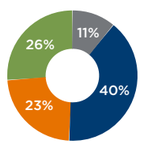
ENERGY SUPPLY BY FUEL – 2024[1] Coal Oil Gas Renewables



North America

North America Energy Mix and Regional Availability

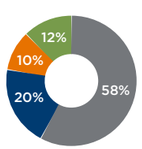
North America's electricity mix is shaped by diverse resource availability, infrastructure networks, and local economics. Natural gas remains dominant across much of the U.S. and Canada due to abundant reserves and extensive pipeline infrastructure that help keep supply affordable and accessible. Coal remains significant in some regions with established resource bases, though its share continues to decline due to economic and regulatory pressures. Wind and solar growth is strongest in the Midwest, Texas, the Southwest, and parts of Canada, where land availability and favorable weather conditions support expansion. Hydropower remains especially prominent in Canada and the Pacific Northwest. Lower-carbon energy sources continue to grow, but regional fuel choices remain driven largely by resource economics, infrastructure, and reliability needs.[1]



Europe

Europe Energy Mix and Regional Availability

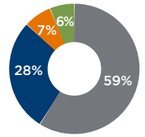
Europe's electricity mix is increasingly lower-carbon, shaped by resource availability and past investment decisions. Nuclear remains a core source in some countries (France, Slovakia, Hungary), while wind is concentrated in northern regions with strong offshore resources (UK, Denmark). Solar is strongest in southern markets (Spain, Italy, Greece), supported by high irradiation. As coal declines, natural gas plays a key role in providing flexible backup. Overall, Europe's energy mix reflects regional resource conditions and the need to balance reliability, affordability, and decarbonization. Hydropower remains dominant in mountainous and water-abundant countries (Norway, Sweden, Switzerland). Solar deployment is concentrated in Southern Europe (Spain, Italy, Greece) where strong year-round irradiation supports rapid growth.[2]



China

China Energy Mix and Regional Availability

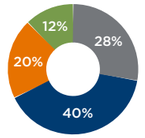
China's electricity mix remains dominated by coal, reflecting its large domestic resource base. Hydropower is concentrated in southern and southwestern regions, while wind and solar continue to expand rapidly in resource-rich areas (Inner Mongolia, Xinjiang, coastal provinces). Nuclear growth is focused along the coast, where infrastructure and regulatory capacity support development. While clean energy continues to scale quickly, coal remains central to affordability and grid reliability, highlighting the role of domestic resources and national priorities in shaping China's energy system.[2]



India

India Energy Mix and Regional Availability

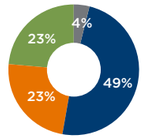
India's electricity mix continues to be led by coal, particularly in eastern and central states where coal resources and rail infrastructure are concentrated. Renewable growth is strongest in western and southern regions, which benefit from high solar irradiation and strong onshore wind resources. India continues to expand renewables through large-scale solar parks, competitive auctions, and national transmission initiatives, but coal remains essential for baseload generation, affordability, and grid reliability.[2]



Rest of Asia

Rest of Asia Energy Mix and Regional Availability

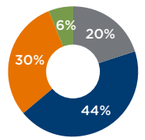
Across the broader Asia-Pacific region, energy mixes vary widely based on resource availability and policy priorities. Southeast Asia (Indonesia, Vietnam, Philippines) continues to rely heavily on coal and natural gas to meet growing demand. Hydropower continues to play a major role in water-rich countries (Laos, Myanmar, Bhutan), while advanced economies (Japan, South Korea) continue to depend on imported LNG, nuclear, and renewables. Across the region, renewable investment continues to increase, but energy systems remain shaped by affordability, resource access, and the need to scale capacity quickly.[2]



South America

South America Energy Mix and Regional Availability

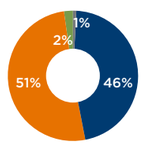
South America's electricity mix is dominated by hydropower, particularly in water-abundant countries (Brazil, Colombia, Peru). Natural gas provides critical backup during dry periods (Brazil, Argentina), supporting reliability when hydro output declines. Wind and solar continue to expand rapidly (Brazil, Chile), where strong resource conditions support growth. While the region benefits from low-cost, lower-carbon resources, reliance on hydropower continues to make reliability sensitive to seasonal and drought-related variability.[2]



Africa

Africa Energy Mix and Regional Availability

Africa's electricity mix varies widely by region, reflecting differences in resource availability and infrastructure. Fossil fuels remain key in resource-rich countries (Nigeria, Algeria, Egypt), while coal continues to play a central role (South Africa). Hydropower remains significant in parts of Sub-Saharan Africa (Ethiopia, Democratic Republic of Congo, Zambia), but output fluctuates with rainfall. Solar continues to expand rapidly (Morocco, South Africa, Egypt), though reliability is often constrained by limited infrastructure and grid integration challenges.[2]



Middle East

Middle East Energy Mix and Regional Availability

The Middle East's electricity mix is dominated by oil and natural gas, reflecting vast hydrocarbon resources (Saudi Arabia, UAE, Qatar). Natural gas is widely used for power generation and desalination, while oil remains important in some markets. Solar continues to expand rapidly (UAE, Saudi Arabia), supported by high irradiation and diversification strategies. The region benefits from abundant domestic supply, but reliability continues to depend on infrastructure investment and managing rising demand.[2]

(1) EIA (2025), Annual Energy Outlook 2025.
(2) IEA (2024), World Energy Outlook 2024.

PILLAR 2

Energy Security

Bespoke energy solutions reflect regional resources and established trade routes

Energy security reflects a nation's ability to access reliable, affordable energy without disruption from external forces. While technology, policy, and decarbonization goals influence outcomes, geography and domestic resource endowment remain the dominant drivers of energy security. Countries with diverse, resilient, and locally controlled energy systems are better positioned to withstand market volatility, geopolitical tension, and supply chain shocks. As energy disruption continues to increase, energy security has become a central priority for governments.

Energy security begins with understanding how much supply is produced domestically versus sourced from abroad, because trade exposure shapes risk, resilience, and policy choices. The median large country fulfills about 70% of its energy needs domestically, but the range is quite broad – spanning from complete self-sufficiency to near-complete reliance on imports, as shown here.[1][2]

Most Import-Dependent Regions and Countries

Countries such as Singapore (99% import reliance), Japan (87%), South Korea (85%), Italy (80%), and Spain (70%) are among the most dependent on imported energy. Across Europe, import dependence remains widespread – particularly in southern Europe and major economies like Italy and Germany – as domestic coal, oil, and gas production has declined. As a result, EU energy self-sufficiency has fallen from 65% in 1994 to 45% in 2025. In Asia, limited domestic fossil resources leave Japan and South Korea highly reliant on imports, while China – though less import-dependent overall (just under 20%) – remains exposed through significant oil import needs, making energy security a central policy priority.[1][3]

Least Import-Dependent/Most Self-Sufficient Countries

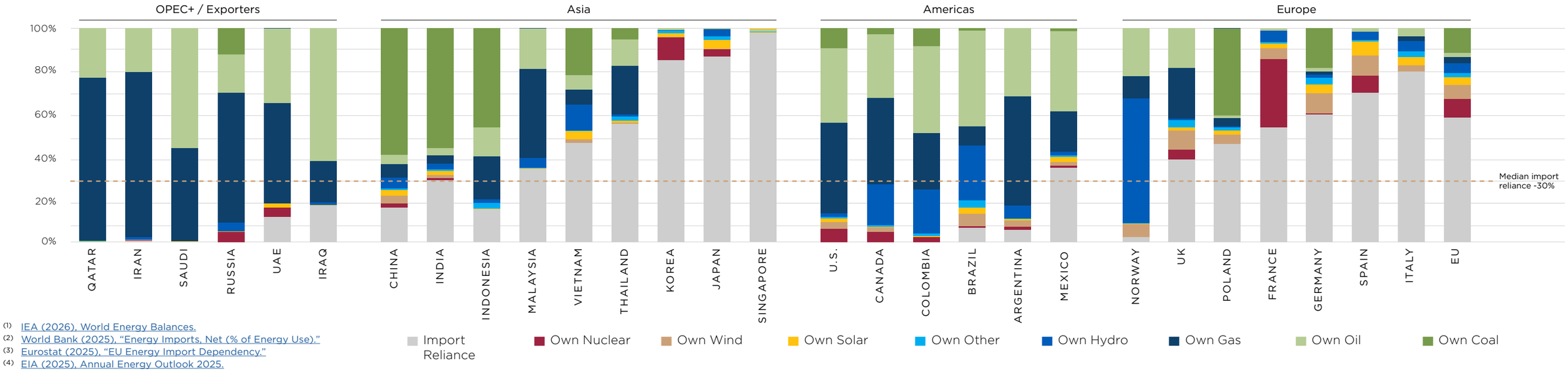
At the other end of the spectrum, some countries produce significantly more energy than they consume, enabling export capacity and greater policy flexibility. Norway (600% self-sufficient), Qatar (400%), Iraq (300%), Saudi Arabia (200%), Indonesia (200%), Russia (170%), and Canada (170%) are among the most self-sufficient energy producers globally.

The U.S. has also shifted into this category following significant domestic hydrocarbon expansion, becoming a net energy exporter for the first time in over 70 years. This transition has strengthened U.S. energy security and reduced exposure to external shocks.[1][4]

Vulnerability and Security Implications

These differences in import dependence have material implications for economic stability, national security, and long-term energy planning. Import-dependent countries are susceptible to energy price spikes, supply disruptions, and geopolitical risks – as shown by Europe's recent gas crisis following supply shocks. Nations with high self-sufficiency face fewer external risks but may still be exposed to domestic production volatility or environmental concerns. Energy security policy is a top priority for highly import-dependent regions, driving diversification efforts, investments in renewables, and the use of strategic fuel reserves and international alliances. The consequences of over-reliance on foreign supply continue to underscore the importance of secure, resilient domestic energy systems.

ENERGY MIX AND IMPORT RELIANCE BY COUNTRY/REGION[5]



(1) IEA (2026), World Energy Balances.
(2) World Bank (2025), "Energy Imports, Net (% of Energy Use)."
(3) Eurostat (2025), "EU Energy Import Dependency."
(4) EIA (2025), Annual Energy Outlook 2025.
(5) Thunder Said Energy, "Energy Self-Sufficiency by Country."

PILLAR 2

Energy Security

Energy power has shifted world events and continues to do so

Global energy leadership has never been static. It has evolved in response to shifting resource advantages, technological breakthroughs, and geopolitical dynamics that reshape how energy is produced, transported, and consumed. From the coal-powered industrial expansion of the 19th century to the rise of oil as the dominant global fuel in the 20th century, each era reflects how nations leveraged their natural resources and infrastructure to drive economic growth and extend geopolitical influence.

The second half of the 20th century marked a turning point, as oil-exporting nations gained greater control over global supply through coordinated production, fundamentally altering energy markets and exposing the vulnerabilities of import-dependent economies. In response, many countries diversified their energy sources, expanded domestic production, and invested in infrastructure to improve resilience and reduce exposure to external shocks.

In the 2000s, the global energy system entered a new phase of technological advancements – particularly in hydraulic fracturing, renewable energy, and battery storage. Energy sources and availability have expanded and shifted traditional supply dynamics. Climate considerations and policy priorities were key drivers of renewable energy deployment, accelerating investment in lower-carbon energy sources. Today, affordability, reliability, and energy security matter in addition to climate considerations.

Access to energy is a critical strategic asset, as highlighted by the Russian invasion of Ukraine and the current Middle Eastern conflict. Seven of eight billion people seek additional energy, while the remaining billion seek stronger energy security. As energy goes, so go nations and the world. Given that energy drives every other industry and underpins human prosperity, the quest for abundant, reliable, and secure energy will continue.

GLOBAL ENERGY TIMELINE[1][2]

1800s

The Coal Era and British Industrial Dominance
Abundant domestic coal fuels manufacturing, transportation, and military strength, enabling rapid economic growth and supporting Britain's emergence as the world's dominant power.

Late 1800s – Early 1900s

The U.S. Emerges as an Energy Leader
The U.S. surpasses the UK in industrial output, fueled first by coal and later by oil, with expanding domestic energy production driving economic growth and underpinning its rise as a leading global power in the 20th century.

Early – Mid 20th Century

Oil Becomes the World's Strategic Fuel
Oil overtakes coal as the dominant global energy source; control over oil supply becomes a central geopolitical priority.

1970s

The Rise of OPEC
Oil-exporting nations consolidate market power through OPEC, coordinating production quotas to influence global prices.

1973

The OPEC Oil Embargo
The OPEC oil embargo exposes Western dependence on imported oil. Industrialized nations respond by diversifying supply sources, boosting efficiency, and expanding domestic energy production.

1990s – Today

China's Energy Evolution
Rapid industrialization drives a dramatic rise in China's energy consumption and global energy demand. By 2009, China surpasses the U.S. as the world's largest energy consumer after more than a century of U.S. leadership. China pursues a dual-track strategy: securing oil and gas supplies while becoming the world leader in solar, wind, and battery manufacturing.

1990s – Today

Climate Policy Reshapes Energy Investment
Climate change instantly rises to the forefront of global policy. Emissions reduction targets and renewable energy incentives accelerate deployment of wind and solar, while debates intensify over affordability and reliability. After 2022, energy security begins to dominate the energy debate over climate change.

2000s – Today

The U.S. Shale Revolution
Breakthroughs in hydraulic fracturing and horizontal drilling unlock vast shale oil and gas resources, transitioning the U.S. from a major importer to one of the world's largest producers of oil and natural gas.

2000s – Today

Emerging Economies Rise
Emerging economies across Asia, Africa, and Latin America increase their share of global demand and reshape the global energy landscape as non-OECD countries surpass OECD countries in energy use.

2022 – Today

Energy Security Takes Center Stage
World conflict in Ukraine and the Middle East disrupts energy flows and highlights the critical nature of energy security and reliability.

PILLAR 2

Energy Security

A small group of nations dominate critical minerals market share

Control over critical minerals and processing capacity directly influences pricing, technology access, and supply stability, with downstream implications for electric vehicles, wind turbines, solar panels, and power grid infrastructure. Supply bottlenecks can delay projects, increase costs, and constrain deployment of clean energy technologies. In response, many countries are investing in new mining projects, recycling initiatives, and alternative supply chains, though meaningful progress is expected to take a decade or more.

Mining by Region

A relatively small group of countries – including China, Australia, Chile, and the Democratic Republic of the Congo (DRC) – dominate global production and reserves of many critical minerals essential to renewable energy and advanced energy technologies. These include rare earth elements, lithium, cobalt, nickel, graphite, and copper. Resource concentration plays a significant role in shaping global energy security, pricing dynamics, and long-term supply availability. South American producers, including Chile, Argentina, and Brazil, along with African nations such as the DRC and South Africa, are becoming increasingly important participants in global supply diversification efforts as countries seek to secure more stable and geographically diversified sources of critical minerals.

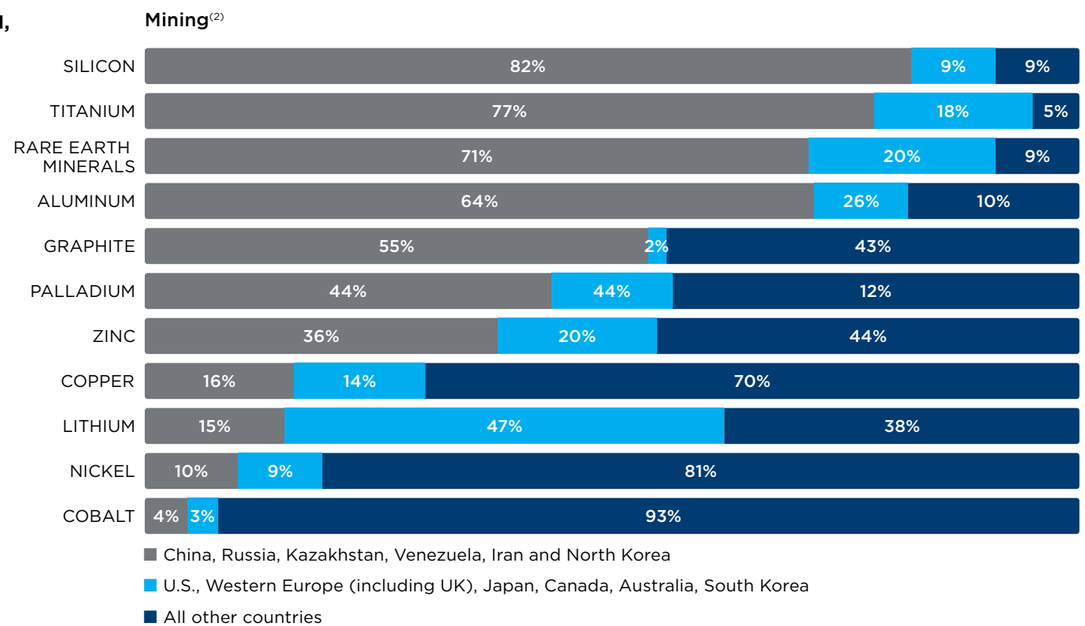
Processing by Region

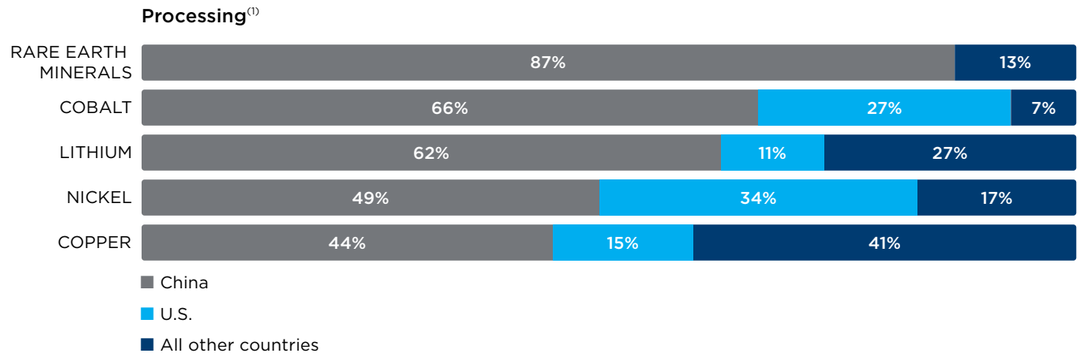
Processing and refining capacity for critical minerals is even more concentrated than mining production. China plays a particularly central role in downstream processing and refining, leading refining capacity for many critical minerals globally. The country controls approximately 92% of rare earth refining, 98% of magnet production, and a substantial share of global processing capacity across multiple minerals. This concentration increases exposure to geopolitical tensions, trade disputes, export controls, and broader supply chain vulnerabilities, particularly for industries dependent on batteries, renewable energy technologies, semiconductors, and advanced manufacturing.[1]

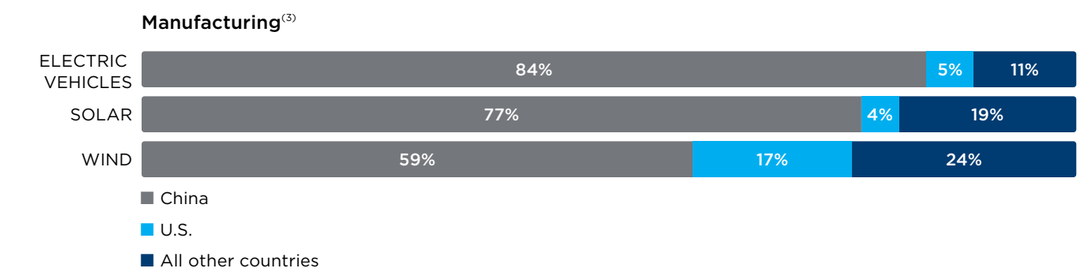
Manufacturing by Region

Manufacturing capacity for many advanced energy technologies is also highly concentrated geographically, particularly in China, which maintains leading market share positions across electric vehicles, solar technologies, batteries, and wind-related supply chains. While this concentration has supported scale and cost efficiency, it has also increased focus on supply chain diversification and domestic manufacturing investment across North America, Europe, and other regions. Over the coming decades, supply chain resilience is expected to become an increasingly important determinant of energy security and industrial competitiveness as demand for critical minerals continues growing.[1]

MINING, PRODUCTION, PROCESSING, AND MANUFACTURING BY REGION – 2023
(Percent)







(1) IEA (2024), Global Critical Minerals Outlook 2024.
(2) USGS (2024), Mineral Commodity Summaries 2024.
(3) BloombergNEF (2024), clean energy manufacturing and supply chain data; U.S. Department of Energy (2024), energy manufacturing data; and Thunder Said Energy (2024), energy transition research.

PILLAR 2

U.S. Energy Leadership

A progress update on the "Golden Era of American Energy Dominance"

CASE STUDY

Energy security is fundamentally about resilience and independence – the ability to meet energy needs reliably while limiting exposure to external shocks, supply disruptions, and geopolitical pressure. Reflecting these priorities, on February 5, 2025, Secretary of Energy Chris Wright released his first Secretarial Order, Unleashing the Golden Era of American Energy Dominance, directing the U.S. Department of Energy (DOE) to accelerate efforts to expand domestic supply, strengthen system reliability, and reinforce America's long-term energy security.

	POLICY PRIORITY	DESCRIPTION
1	Advance Energy Addition, Not Subtraction	**Net-zero policies raise costs and threaten reliability while delivering limited global emissions reductions. The Department will focus on expanding American energy abundance to power modern life and restore durable U.S. energy dominance.**
2	Unleash American Energy Innovation	DOE will direct R&D efforts toward technologies that strengthen U.S. scientific leadership, improve reliability, lower costs, and enhance manufacturing competitiveness. Priorities include fossil energy, advanced nuclear, geothermal, hydropower, and breakthrough technologies such as fusion, high-performance computing, quantum, and AI. DOE will review its R&D portfolio and enforce milestones to ensure cost-effective use of taxpayer funds.
3	Return to Regular Order on LNG Exports	**DOE has resumed processing LNG export applications to non-Free Trade Agreement countries in accordance with the Natural Gas Act. America's energy abundance is an asset, and lawful consideration of LNG applications will proceed as required.**
4	Promote Affordability and Consumer Choice in Home Appliances	DOE will review the Appliance Standards Program to ensure standards reflect actual costs and savings. The approach will prioritize affordability, consumer choice, and preventing regulations from removing valued products from the market.
5	Refill the Strategic Petroleum Reserve (SPR)	The SPR is a critical national asset and must be restored from historically low levels. DOE will develop plans to refill the reserve and safeguard its infrastructure.
6	Modernize America's Nuclear Stockpile	DOE will continue its mission to modernize and steward the nation's nuclear weapons enterprise, strengthen deterrence, and advance peaceful nuclear technologies and nonproliferation efforts.
7	Unleash Commercial Nuclear Power in the U.S.	**DOE will work to accelerate the deployment and global export of next-generation nuclear technologies, positioning America to lead the long-awaited nuclear renaissance as global energy demand rises.**
8	Strengthen Grid Reliability and Security	Under the National Energy Emergency Executive Order, DOE will use all lawful authorities to fortify the grid and expand baseload and dispatchable generation. With electricity demand rising sharply after decades of slow growth, the focus will be on ensuring reliable, secure power for the nation.
9	Streamline Permitting & Remove Burdens on American Energy	**DOE will accelerate permitting processes and identify undue regulatory barriers to enable energy infrastructure development, strengthen competitiveness, and support affordable, reliable, secure energy delivery.**

Reopening Drilling and Returning to Regular Order LNG Exports

To support increased exploration and production on federal lands and waters, the Bureau of Land Management advanced multiple oil and gas lease sales during 2026. In May, the agency leased 74 parcels across New Mexico and Texas, generating more than $4 billion in receipts. BLM also proceeded with oil and gas lease sales in Nevada, including sales announced for March and June 2026.[1][2] In addition, the Administration finalized a rollback of prior restrictions in the Arctic, reopening areas of the Arctic National Wildlife Refuge and the National Petroleum Reserve-Alaska for oil and gas development.[3] Additionally, second-wave LNG export projects currently under construction are expected to increase U.S. LNG export capacity from approximately 14 Bcf/d in 2024 to nearly 30 Bcf/d by 2030, while a new wave of final investment decisions (FID) announced in 2025 could add another ~10 Bcf/d of capacity in the early 2030s.[4]

▶ **See policy priorities 1 and 3 in table.**

Nuclear Acceleration

The U.S. made meaningful progress on advanced nuclear deployment over the past year, driven by a renewed focus on energy security and long-duration, zero-carbon power. In June 2025, the Department of Energy launched the Reactor Pilot Program, opening applications for advanced reactor projects to be built and operated outside of national laboratories.[5] The initiative provides a more streamlined pathway for early-stage construction by allowing the DOE authorization for pilot units, rather than requiring full Nuclear Regulatory Commission licensing in the demonstration phase. By August 2025, DOE had identified an initial group of projects for further evaluation, marking the first material step toward deploying a new generation of reactors. These actions build on the Administration's stated goal of bringing multiple advanced reactors to criticality by 2026 and reflect a broader shift toward treating nuclear energy as a strategic asset for reliability and national competitiveness.[5]

▶ **See policy priority 7 in table.**

Permitting Reform

The U.S. also advanced several efforts to accelerate the permitting and siting of energy infrastructure. Beginning in early 2025, federal agencies introduced new procedures intended to shorten environmental reviews, improve interagency coordination, and provide clearer timelines for applicants. These reforms were paired with updates to major federal permitting statutes, including provisions aimed at reducing duplicative analysis and setting firm deadlines for approving critical infrastructure such as transmission lines, pipelines, and export facilities.[6] While implementation will take time, these steps reflect growing consensus that long lead times for major energy projects pose a risk to reliability, investment planning, and broader economic performance. The trend is toward faster, more predictable permitting while maintaining environmental standards.[7]

▶ **See policy priority 9 in table.**

(1) Bureau of Land Management (2025), "BLM Seeks Initial Input for May 2026 Sale of Oil and Gas Leases in New Mexico and Texas."
(2) Bureau of Land Management (2025), "BLM Seeks Initial Input for June 2026 Sale of Oil and Gas Leases in Nevada."
(3) World Oil (2025), "Trump Finalizes Rollback of Arctic Drilling Restrictions."
(4) EIA (2025), Annual Energy Outlook 2025: Legislative and Regulatory Assumptions.
(5) U.S. Department of Energy (2025), "U.S. Department of Energy Reactor Pilot Program."
(6) U.S. Congress (2024), Energy Permitting Reform Act of 2024.
(7) Bipartisan Policy Center (2024), "The Energy Permitting Reform Act of 2024: What's in the Bill?"

PILLAR 2

Europe's 2022 Energy Crisis

Why energy abundance is essential for economic resilience

CASE STUDY

Before Russia's invasion of Ukraine in February 2022, Europe relied heavily on Russian pipeline gas, which supplied roughly 40% of the EU's natural gas imports and a meaningful share of its overall energy mix. This concentration of supply left the region exposed to geopolitical disruption. Russia's invasion of Ukraine triggered the most severe energy security shock Europe had faced in decades. When pipeline deliveries declined sharply – as Russia curtailed flows and used gas exports as a geopolitical lever – benchmark gas prices in northwest Europe rose rapidly, and electricity prices followed as gas-fired generation set marginal power prices across much of the continent.[1]

Although storage withdrawals, long-term contracts, and hedging mechanisms initially provided some insulation, households and businesses ultimately experienced substantial increases in energy costs. Demand destruction followed as energy-intensive industries – including chemicals, fertilizers, metals, and manufacturing – reduced output or paused operations when feedstock and power costs exceeded economically viable thresholds.

Rapid Infrastructure Expansion and Demand Adjustment

Europe responded to the disruption with an unusually fast combination of infrastructure deployment and demand management. LNG imports increased significantly between 2021 and 2023 as floating import terminals were installed and regasification capacity expanded. The speed of this buildout was notable. Shortly after the invasion, Germany announced plans to develop its own LNG infrastructure, beginning with interim floating units and transitioning to permanent land-based facilities over time. The first floating import terminal was inaugurated in December 2022 – only ten months after the invasion – demonstrating how quickly new supply routes can be established when energy security becomes urgent. Europe's existing LNG import and pipeline infrastructure further supported the rapid expansion of additional import capacity across the region.

Since Russia's invasion of Ukraine, Europe has added approximately 10 billion cubic feet per day of new LNG regasification capacity, enabling a roughly 60% increase in LNG imports between 2021 and 2023. This expansion displaced an estimated 40% of pre-invasion Russian gas supplies.

Beginning in mid-2022, conservation efforts and policy shifts reduced European natural gas demand by approximately 5 billion cubic feet per day. By 2023, consumption was roughly 2 Bcf/d below historical averages as LNG imports offset some of the previous demand curtailments. These behavioral and policy-driven reductions – combined with increased renewable generation and relatively mild weather – helped offset the dramatic decline in Russian pipeline imports, boosting energy security and contributing to record gas storage levels across the region. Together, these adjustments helped stabilize winter supply conditions and demonstrated that infrastructure investment, diversified procurement, and coordinated demand reduction can materially improve energy system resilience when implemented.[1][2]

Fiscal Intervention and Industrial Consequences

Despite these efforts, the economic effects were substantial. European governments introduced price caps, tax adjustments, and subsidies to protect consumers and maintain supply chains, shifting a significant portion of energy costs to public budgets. The region's energy import bill increased sharply during the crisis period, contributing to inflation and placing pressure on household budgets.

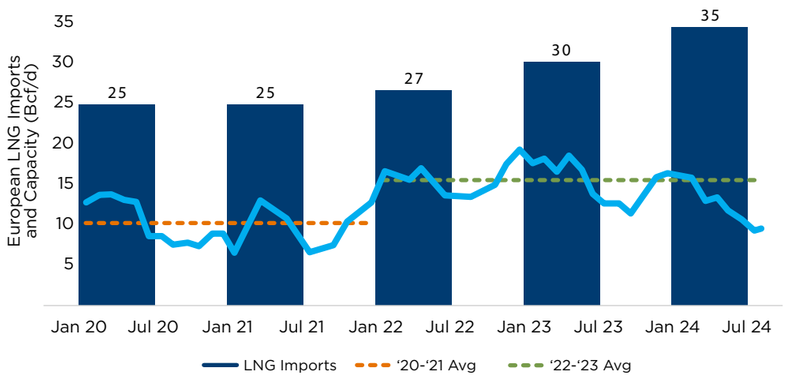
Industrial competitiveness weakened as firms faced prolonged price volatility and uncertainty around future supply costs. In some cases, maintaining system stability required emergency measures, including temporary industrial shutdowns, government intervention in energy markets, and support for critical utilities. Energy procurement strategies were fundamentally reshaped as companies diversified sourcing, reassessed long-term contracts, and incorporated energy price risk more explicitly into investment decisions. While prices moderated from their peak by 2023, the structural vulnerabilities exposed during the crisis remained evident.[1]

Implications for Energy Abundance

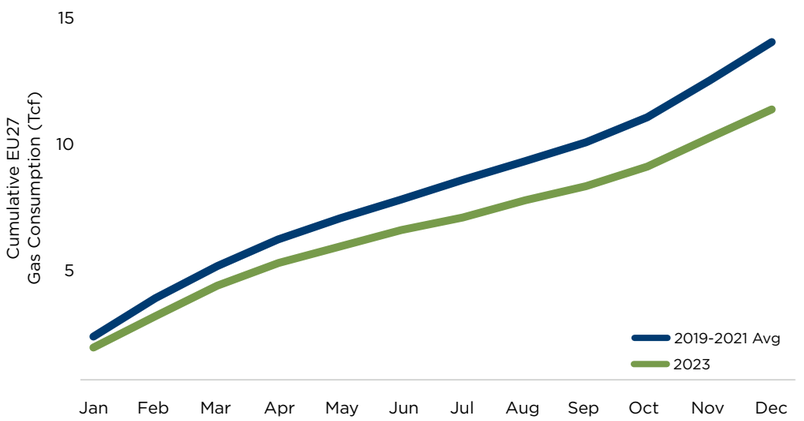
Europe's experience illustrates that affordability, access, and resilience are interdependent features of energy systems. When supply routes are concentrated, storage is limited, or infrastructure expansion is constrained, price volatility and supply risk can rise rapidly – even in advanced economies with modern infrastructure. When supply is concentrated and flexibility is limited, disruptions can propagate quickly through prices, industrial output, and economic growth.

At the same time, Europe's rapid LNG buildout and coordinated demand reductions demonstrate that system flexibility can be restored when policy alignment, infrastructure investment, and market incentives converge. For both developed and emerging markets, diversified supply portfolios, scalable infrastructure, and predictable energy costs remain foundational to industrial strength, investment stability, and long-term economic growth.

TRENDS IN EUROPEAN LNG IMPORTS AND CAPACITY – 2020–2024[2]



CUMULATIVE EU GAS CONSUMPTION – 2023 vs. 2019–2021 AVERAGE[3]



(1) IEA (2024), World Energy Outlook 2024.
(2) Institute for Energy Economics and Financial Analysis (2024), "European LNG Tracker." Bloomberg.
(3) Bruegel (2024), "European Natural Gas Imports Tracker."

PILLAR 2

2026 U.S.-Iran Conflict

World energy security threatened with strait closure

CASE STUDY

In early 2026, escalating conflict involving Iran, Israel, the U.S., and regional proxy groups triggered one of the largest global energy disruptions in modern history. What began as a regional military confrontation evolved into a broader energy security issue centered around the Strait of Hormuz – one of the world's most critical energy chokepoints. As of publication, the conflict remains fluid, disrupting global oil and LNG flows, tightening already constrained post-shale energy markets, and reinforcing the strategic importance of reliable North American energy supply. While conditions remain dynamic and outcomes uncertain, the crisis underscores how geopolitical instability can rapidly reshape global energy markets and energy security priorities.

Evolving Supply Dynamics

Following escalating tensions surrounding Iran's nuclear program and regional proxy activity, military confrontation expanded across the Persian Gulf and surrounding waterways in early 2026. The conflict quickly disrupted global energy transportation and maritime trade flows. The Strait of Hormuz – through which roughly one-fifth of global petroleum liquids and LNG flows transit – became the focal point of the disruption. The initial attacks and ongoing blockades significantly reduced crude oil and LNG flows while increasing market volatility. Related disruption risks moderated with the announcement of a cease-fire, but tensions remain and the conflict could continue and even expand into the Red Sea, Bab el-Mandeb Strait, and Suez Canal, threatening additional trade routes and critical supply chains.

Historical Supply Disruptions

The current conflict is impacting both current production and global spare production capacity, amplifying the impact of supply disruptions relative to prior geopolitical events. Previous events, including the 1973 Arab Oil Embargo, the Iranian Revolution, and Gulf War I, disrupted approximately 5% to 10% of global oil supply. By comparison, current disruptions have approached roughly 20% of global production flows at peak conditions and effectively eliminated spare production capacity.[1] Elevated disruption volumes and limited supply flexibility have increased concerns regarding price volatility, inventory adequacy, and long-term energy reliability.

HISTORICAL OIL SUPPLY DISRUPTIONS, GLOBAL SPARE CAPACITY, AND REAL CRUDE PRICES[1]

CRISIS	% WORLD SUPPLY DISRUPTED	% WORLD SPARE CAPACITY AVAILABLE
Suez Crisis (1956–57)	~10%	~35%
Arab Oil Embargo (1973)	~7%	~8%
Iranian Revolution (1978–79)	~5%	~5%
Gulf War I (1990–91)	~9%	~4%
Current conflict	~20%	~0%

Long-term Implications of the Disruption

Although the outcome and duration of the ongoing conflict remain uncertain, it will have broader implications for global energy markets. As the second major energy disruption in recent years, it has reinforced energy security as a critical national priority for countries around the world. Each country's response will reflect its domestic energy resources, import dependence, supply chains, and national priorities. Following the Arab oil embargoes of the 1970s, countries pursued a range of strategies, including France's expansion of nuclear power, advances in renewable energy technologies, and increased investment in domestic energy resources – including the eventual development of shale oil and natural gas in the U.S. Potential implications of the current disruption could include one or more of the following scenarios:

- Prioritization of North American energy resources given the higher reliability and available supply chains
- Doubling down of renewable energy resources to diversity away from less secure Middle Eastern hydrocarbon supplies
- Accelerated advancements and engagement of nuclear energy that has seen decades of limited adoption
- Increased research and development into other alternative energy sources
- Renewed interest in conservation and energy efficiencies to reduce energy usage and import dependencies

Regardless of how the current conflict is resolved, its effects will likely ripple across global energy markets for decades. As the world works to meet ever-increasing demand with abundant, reliable, and clean resources, energy security will shape priorities in the immediate future.

[1] Rapidan Energy Group, EIA, BP, St. Louis Fed, U.S. Senate. Note: spare capacity figures are Rapidan estimates as of 3/9/26.

PILLAR 2

Energy Resilience

Why balance and diversification matter

In a world of accelerating climate risks, geopolitical shifts, and changing demand patterns, energy resilience has emerged as a defining measure of stability and strength. It reflects not only a system's ability to deliver energy, but its capacity to adapt – to recover quickly from shocks, manage variability, and sustain continuity under pressure.

Every energy source has distinct attributes, and no single source provides a complete solution. Energy system resilience is achieved through diversity, not overreliance on any one fuel or technology. It comes from balance: the deliberate integration of diverse, complementary resources that together help provide reliability, flexibility, and affordability across all conditions.

Energy Attributes

The table below compares key attributes that shape how each energy source contributes to a resilient, reliable, and lower-carbon energy system.

High = Strong fit for this attribute
Medium = Moderate fit; context dependent
Low = Limited fit for this attribute

ENERGY SOURCE	Abundant Readily available to meet global demand	Affordable Cost-effective options that support economic stability	Reliable Dependable in a variety of conditions	Flexible Dispatchable and adaptable to changing needs	Social Acceptance Generally accepted by communities and stakeholders	Lower-Carbon Lower emissions help advance climate goals
Solar/Wind	HIGH Widely available in many regions with strong resource potential	HIGH Low operating cost; costs continue to decline	LOW Variable output dependent on weather and time of day	LOW Intermittent; requires storage or backup for firm supply	HIGH Broad public support in many regions; minimal local impacts	HIGH Very low emissions over asset life
Hydropower	LOW Geographically limited by water resources and geography	MEDIUM Low operating cost; high upfront capital	HIGH Consistent and dispatchable with storage capability	MEDIUM Flexible output and ramping; depends on reservoir conditions	MEDIUM Generally accepted but can face local concerns (e.g., ecosystems, resettlement)	HIGH Very low emissions over asset life
Biomass	MEDIUM Feedstock availability varies by region	MEDIUM Moderate cost; sensitive to feedstock and transportation	MEDIUM Weather-dependent feedstock supply and potential sustainability constraints	MEDIUM Flexible with adequate feedstock supply and logistics	MEDIUM Acceptance varies; concerns about air quality, land use change, and biodiversity	MEDIUM Lower emissions than fossil fuels with sustainable feedstocks
Nuclear	MEDIUM Fuel is energy dense and globally available	MEDIUM High upfront cost; low operating cost	HIGH Very reliable baseload with high capacity factor	LOW Limited ramping; best suited for steady baseload operation	LOW Mixed public perception; concerns about safety, radioactive waste, and accident risk	HIGH Very low emissions over asset life
Natural Gas	HIGH Abundant domestic supply in many regions	HIGH Relatively low cost and competitive	HIGH Highly reliable and dispatchable	MEDIUM Fast start and ramping; ideal for peaking and balancing	MEDIUM Generally accepted but increasing concerns about methane emissions	MEDIUM Lower emissions than coal and oil; emits CO_2 when used
Oil	MEDIUM Globally available but subject to price volatility	MEDIUM Higher and more volatile cost	HIGH Reliable and easily stored	HIGH Easily transported around the world	MEDIUM Pervasive but carries more environmental impacts and spill risks	LOW Higher emissions intensity
Coal	HIGH Abundant in many regions with large reserves	HIGH Low cost and established infrastructure	HIGH Reliable baseload with high capacity factor	LOW Slow ramping; not well suited for load following	LOW Low acceptance due to air pollution, health impacts, and land use	LOW Highest emissions intensity

Based on Quantum internal opinions and analysis. Attributes reflect typical performance of each energy source. Outcomes vary based on location, technology, infrastructure, and operating context.

PILLAR 2

Winter Storm Uri

Strengthening grid resilience after system failure

CASE STUDY

In February 2021, a historical winter storm swept across much of the South and became the first billion-dollar weather disaster of the year. Texas experienced the most severe impacts, with widespread power outages affecting nearly 10 million people during what was the state's coldest winter storm since 1989. Without power to heat homes or cook and limited access to clean water due to burst pipes and boil notices, many residents endured severe hardship. The crisis resulted in more than 200 deaths.[1]

The devastating losses due to grid failure and power outages put the state's power generator, the Energy Reliability Council of Texas (ERCOT), under intense scrutiny and pushed energy reliability to the forefront of Texas politics. Since then, ERCOT has focused on strengthening system resilience, creating redundancies across the grid, and expanding available supply to meet increased demand.

What Went Wrong?

Winter Storm Uri exposed critical gaps in ERCOT's preparedness for sustained extreme weather. Insufficient winterization across generation assets, limited fuel supply resilience, and the grid's isolation from neighboring systems left Texas unable to meet surging power demand as temperatures plunged. In the aftermath, ERCOT and state regulators initiated reforms to strengthen grid reliability, enhance forecasting, and require cold-weather readiness standards, marking a pivotal shift toward systemwide energy resilience.[2]

Reserve Margins In Texas Have Improved Drastically Since Uri

Reserve margins are a key measure of grid reliability, calculated as the ratio of available power generation resources to anticipated peak demand. The North American Electric Reliability Corporation (NERC) suggests maintaining margins above 15% to ensure reliable power, limiting the risk of a loss-of-load event to once per decade.

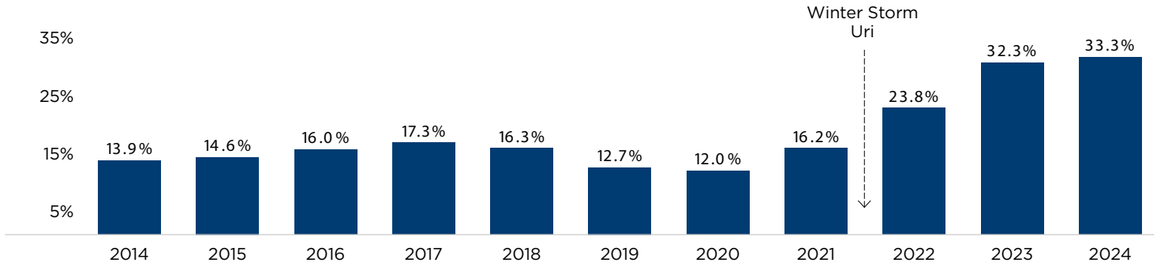
ERCOT's anticipated reserve margins have improved markedly over the last decade, supported by a more balanced power generation mix that reduces reliance on any single energy source. By contrast, when the storm struck in February 2021, ERCOT's reserve margin had fallen to a decade low – just 12% in 2020 – leaving the system highly vulnerable.

Since then, reserve margins have climbed sharply, reaching 33–34% in 2024. Forecasts suggest margins could exceed 40% in 2025 and remain above 37% through 2033 under current capacity and demand scenarios. While ERCOT targets a minimum reserve margin of 13.75%, slightly under the NERC recommendation, actual margins are now routinely much higher due to significant growth in wind, solar, and natural gas capacity.[3]

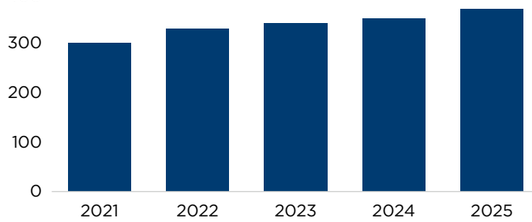
ERCOT Meets Fast Growing Demand with a Balanced Approach

Since Winter Storm Uri in 2021, electricity demand in Texas has continued to grow, reaching record highs in 2025. As of 2023, wind and solar – particularly utility-scale solar – have been the fastest-growing sources of electricity and are critical to meeting rising demand. ERCOT is building a more resilient grid by evaluating how each resource performs during peak conditions.

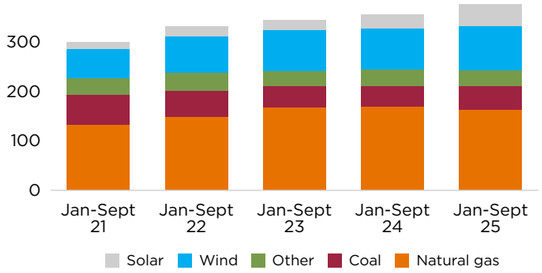
ERCOT ACTUAL RESERVE MARGINS – 2014-2024[4]



ERCOT ELECTRICITY DEMAND – JAN–SEPT, 2021-2025[4]



ERCOT ELECTRICITY GENERATION – JAN–SEPT, 2021-2025[5]



Wind-only load peaks often coincide with lower reserve margins, as output is intermittent and can drop during peak summer evening demand, particularly during calm, low-wind periods. Gas-only systems are more reliable for peak demand but expose the grid to fuel supply risks, extreme weather disruptions, and price volatility. Plants may also be offline due to fuel constraints or unplanned maintenance, creating potential shortfalls.

Combining wind and solar with flexible natural gas helps maintain generation availability during periods of peak load and low renewable output, strengthening reserve margins and improving system reliability. Solar provides strong midday output, while wind typically ramps up later at night after peak demand tapers off. Gas can be dispatched quickly when solar declines and renewable output is low, providing coverage across the day.

ERCOT's planning increasingly prioritizes coordinated investment across wind, solar, gas, and storage to maintain reserves and manage periods when any single resource underperforms – supporting a more resilient grid capable of withstanding extreme weather events, rapid demand growth, and evolving system conditions.

(1) ERCOT (2021), Final Report on Winter Storm Uri.
(2) NERC (2021), The February 2021 Cold Weather Outages in Texas and the South Central United States.
(3) ERCOT (2025), Capacity, Demand and Reserves Report.
(4) ERCOT (2025), reserve margin and electricity demand data.
(5) ERCOT and EIA (2025), ERCOT electricity generation mix data.

PILLAR 2

Energy Resilience Solutions are Country Specific

Area resources, supply chains, and economics drive solutions

CASE STUDY

Global energy systems are undergoing a fundamental reprioritization. After a decade dominated by decarbonization-first narratives, 2025–2026 have triggered a decisive market shift. Governments are refocusing on abundance, affordability, reliability, and national competitiveness. Industrial activity is rising, AI demand is compounding grid stress, and public tolerance for expensive climate obligations is eroding. Energy strategy is now being shaped by physical constraints, rising demand, and a return to pragmatic decision-making rather than linear emission-reduction pathways.

The data increasingly point to a future of materially higher energy demand. Thunder Said Energy's 2025 update raised its global 2050 useful-energy demand forecast by 17%, reaching nearly 140,000 TWh, driven by population growth, industrialization, electrification, and the rapid expansion of AI, especially physical AI, unlocking new demand in autonomous vehicles and robotics.[1]

The implications for infrastructure are substantial. In the U.S., power-system capacity may need to grow from roughly 1,300 GW today to approximately 3,000 GW by 2050. At the same time, total grid circuit-kilometers may need to nearly triple to support rising electricity demand, greater electrification, and the operational requirements of increasingly renewable-heavy power systems.[1]

In this environment, energy diversity is not a slogan – it is a resilience strategy. Relying solely on one form of energy exposes nations and regions to heightened risk from supply disruptions, price volatility, and technical failures, which directly impact economies, national security, and the well-being of citizens.

Furthermore, no single technology can deliver reliability, affordability, security, and lower emissions at global scale. This reality dispels the notion of a one-for-one "energy transition." The world is not replacing hydrocarbons with wind, coal with solar, or fossil fuels with hydrogen. It is moving towards an energy addition, system redundancy, geographic diversification, and multi-fuel architectures. Every credible model – including the Energy Institute, IEA, EIA, and Thunder Said Energy shows absolute growth across hydrocarbons, renewables, nuclear, and the enabling infrastructure required to support them.[2] The only open question is the ratio – which varies by geography, industrial base, and political appetite.

A diverse portfolio helps ensure that energy remains abundant and affordable, supply chains are resilient and secure, and emissions decline through multiple complementary pathways. As a result, energy systems are increasingly diverging across regions, reflecting differences in resource availability, infrastructure, economic priorities, and security considerations. Economic pragmatism and deployment timelines are essential prerequisites for a successful energy future, which must rely on a diverse set of solutions across varying technologies.

Regional Divergence: Different Systems, Shared Logic

The global energy system is not converging toward a single, uniform model. Instead, regional pathways are diverging – shaped by differences in resource endowment, industrial strategy, technology competitiveness, policy priorities, and political risk tolerance. As countries seek to balance affordability, reliability, security, and emissions reduction, they are pursuing energy solutions tailored to their unique circumstances. China and the U.S. provide two of the clearest examples of this trend.

China: Industrial Leverage via Renewables + Coal + Nuclear

China remains anchored in coal, yet invests in solar, wind, batteries, and nuclear at unprecedented scale. Solar module additions surpassed 800 GW in 2025 and are projected to exceed 1 TW/year by 2027 – the single largest annual deployment of any energy technology ever recorded.[3] This approach reflects China's unique combination of industrial competitiveness, energy security, and environmental priorities.

▶ Industrial dominance

China controls the majority of global critical-mineral processing and clean-tech manufacturing, allowing it to capture global value chains and economies of scale.

▶ Urban air-quality gains

Large-scale solar and batteries reduce reliance on coal at the margin, helping curb $PM_{2.5}$ and smog in dense megacities – a top domestic priority.

▶ Electricity for industrial expansion

Renewables support rising industrial electricity loads without jeopardizing competitiveness or requiring imported fuels.

China is not "transitioning away from coal." Instead, it is accumulating energy options – coal for baseload stability, nuclear for firm power, and renewables for marginal growth – while reinforcing industrial power, improving air quality, and extending China's leverage across global supply chains.

U.S.: Hydrocarbon Platform + Infrastructure Depth + Selective Lower-Carbon Growth

The U.S. has become the world's hydrocarbon engine. Massive shale resources, deep pipeline networks, abundant storage, and LNG export capacity make natural gas the backbone of U.S. reliability and one of the country's largest sources of geopolitical influence.

Even in a deeply decarbonized scenario, Thunder Said Energy's 2050 U.S. model shows a nearly 3,000 GW power system composed of:

1,400 GW	400 GW	800 GW	150 GW
Solar	**Wind**	**Natural Gas**	**Nuclear**

Alongside this expansion, electricity's share of useful energy rises from 30% today to 60% by 2050, reflecting electrification of transport, industry, and digital ecosystems.[1] This outlook is not an energy transition away from hydrocarbons. It is an energy expansion that incorporates abundant domestic hydrocarbons, rapidly scaling renewables, firm nuclear power, and a massive build-out of grid, transmission, and storage infrastructure. The U.S. pathway reflects system depth, technological diversity, and the flexibility of a market-driven energy ecosystem.

The Global Convergence Point

Despite different architectures, China and the U.S. embody the same underlying logic:

Diversity = Resilience
Addition = Growth
Optionality = Competitiveness

While the pathways differ, both countries are pursuing energy systems designed to support long-term economic growth, energy security, and prosperity.

(1) Thunder Said Energy (2025), Roads to Net Zero Research Series.
(2) Energy Institute (2025), Statistical Review of World Energy.
(3) IEA (2025), Renewables 2025.

PILLAR 3

Energy Cleanliness

Addressing immediate health issues and long-term potential impacts of global warming

Clean energy is a core pillar of a sustainable global energy system. But delivering it requires pragmatism. The world must reduce the pollutants that harm people today and the greenhouse gases that impact the climate over time – all while maintaining the access, affordability, security, and reliability that underpin modern life. Cleanliness cannot come at the expense of energy availability and reliability; restricting access or raising costs can slow economic development and, in many cases, worsen the very health and environmental outcomes such actions are intended to improve. A pragmatic cleanliness agenda recognizes that progress depends on lowering emissions per unit of useful energy, improving human health, and maintaining affordable and secure energy systems.

Energy cleanliness has two distinct but interconnected dimensions, both of which are essential to human well-being. The first is immediate air-quality and environmental cleanliness. This includes reducing pollutants such as particulate matter, sulfur dioxide, nitrogen oxides, and black carbon that contribute to urban smog, respiratory illness, cardiovascular disease, and poor indoor air quality. These impacts are local, immediate, and highly visible. In many developing regions, the absence of modern energy access remains one of the largest contributors to poor air quality, as households continue relying on wood, charcoal, crop waste, and other solid fuels for cooking and heating. Expanding access to cleaner and more reliable energy sources can therefore produce immediate improvements in public health, quality of life, and economic productivity.

Historically, improvements in air quality have closely followed improvements in energy systems. As societies gain access to more modern, abundant, and reliable energy, they tend to move away from higher-polluting fuels and technologies toward cleaner infrastructure and more efficient systems. Many developed economies significantly reduced particulate pollution, sulfur dioxide, and other harmful pollutants over recent decades through cleaner fuels, stronger environmental standards, improved industrial technologies, and expanded energy infrastructure. This progression highlights an important reality: economic development and environmental improvement are often interconnected rather than competing priorities.

The second dimension is long-term climate cleanliness, which focuses on reducing greenhouse gas emissions that contribute to global warming and long-duration climate risks. This dimension addresses the accumulation of carbon dioxide, methane, and other greenhouse gases in the atmosphere over time. Climate cleanliness matters, but it cannot come at the expense of access or affordability. If efforts to cut emissions make energy harder to obtain or more costly, they can slow economic development and make it more difficult for communities to address basic health and air-quality challenges. Durable progress therefore requires approaches that are economically practical, technologically scalable, and compatible with growing global energy demand.

These two dimensions overlap, but they are not always aligned. Some energy systems may reduce greenhouse gas emissions while remaining costly or difficult to scale reliably. Others may significantly improve local air quality and affordability while delivering more gradual climate benefits. Effective energy strategies must recognize both dimensions simultaneously. Long-term climate goals matter, but they cannot come at the expense of the immediate health, affordability, and reliability needs that support human development and economic stability today.

THE TWO DIMENSIONS OF ENERGY CLEANLINESS

DIMENSION 1

Immediate Health Impacts

Local • Today • Direct

Addresses pollutants that affect the air people breathe every day and have direct, immediate impacts on human health.

Key Pollutants	Health Impacts	Major Source in Developing Regions	Benefits of Progress
PM, SO_2, NO_x, black carbon	Respiratory illness, cardiovascular disease, poor indoor air quality	Use of wood, charcoal, crop residues, and animal dung	Improved public health, quality of life, and economic productivity

Both Dimensions are Essential

DIMENSION 2

Long-term Climate Impacts

Global • Long-term • Cumulative

Addresses the accumulation of greenhouse gases that drive long-term warming and climate risk.

GHG Emissions	Climate Risks	Pragmatic Approach	Why It Matters
CO_2, methane, and other greenhouse gases	Rising temperatures, extreme weather, sea level rise	Solutions must be economical, scalable, and compatible with growing demand	Emissions reduction must support development and human prosperity

History Shows Progress Is Possible

Historically, improvements in air quality have followed improvements in energy systems, infrastructure, and economic development. Cleaner fuels, modern technologies, expanded electricity access, and stronger standards have significantly reduced harmful pollutants in many developed economies.

Access And Affordability Are Essential

Climate cleanliness matters, but it cannot come at the expense of access or affordability. If efforts to cut emissions make energy harder to obtain or more costly, they can slow development and make it more difficult to address basic health and air-quality challenges.

The Goal is Pragmatic Progress

Lowering emissions per unit of useful energy while maintaining affordable, reliable, and secure energy systems for people everywhere

- **Improve human health and quality of life**
- **Maintain affordable, secure, and reliable energy systems**
- **Support human development and economic stability**

PILLAR 3

Health – Immediate Dimension of Energy Cleanliness

Air pollutants have serious impacts on human health

Cleanliness is not only about greenhouse gases; it is also about protecting human health. The immediate dimension of energy cleanliness focuses on the air people breathe every day and the pollutants that directly impact communities around the world. Air-quality cleanliness addresses pollutants such as particulates, nitrogen oxides, sulfur dioxide, and black carbon that contribute to respiratory illness, cardiovascular disease, poor indoor air quality, and urban smog. These impacts are immediate, local, and highly visible, making them one of the most direct human consequences of how energy is produced and consumed.

In many parts of the world, access to modern energy remains limited, forcing households to rely on traditional solid fuels for cooking and heating. Wood, charcoal, coal, crop residues, and animal dung are often burned in open fires or inefficient stoves inside poorly ventilated homes, creating dangerous levels of indoor smoke and particulate pollution. These exposures occur directly inside homes and disproportionately affect women and young children. Globally, roughly 2.3 billion people still rely on traditional fuels for cooking and heating, and the World Health Organization estimates household air pollution causes approximately 3.2 million premature deaths each year. In many developing regions, expanding access to cleaner and more reliable energy sources remains critical to improving air quality and public health.(1)

Urban air pollution presents a parallel challenge. In dense, fast-growing cities, emissions from transportation, industry, and coal-fired generation create chronic respiratory and cardiovascular risks. While the sources differ, the outcome is the same: air quality remains one of the world's most significant energy-related health challenges.

Rapid industrialization, population growth, aging infrastructure, and concentrated transportation activity often intensify pollution in major urban centers. Severe smog events can disrupt daily life, reduce visibility, strain healthcare systems, and increase hospital visits tied to asthma, heart disease, and other respiratory conditions. Unlike many long-term environmental challenges, these impacts are immediate, visible, and measurable, making air-quality improvement one of the most tangible forms of environmental progress.

Many countries have demonstrated that meaningful reductions in urban air pollution are achievable through cleaner fuels, emissions-control technologies, improved industrial efficiency, expanded natural gas infrastructure, modernized transportation systems, and stronger environmental standards. These efforts have shown that harmful pollutants can be reduced alongside continued economic growth and rising energy demand when supported by pragmatic infrastructure investment and technological advancement.

From Quantum's perspective, improving air quality is both a cleanliness and development opportunity. Transitioning households from uncontrolled solid fuels to cleaner hydrocarbons such as LPG or pipeline gas – or to modern electricity – delivers immediate health benefits while also reducing climate-relevant emissions. These shifts lower particulate exposure, reduce black carbon, and move families toward safer, more reliable energy systems. Cleanliness therefore cannot be measured only by emissions intensity, but also by how effectively energy systems improve human health, reduce harmful pollution exposure, and expand access to modern energy.

SPOTLIGHT

China's Air Quality Crisis of the 2010s

Rapid industrialization and urbanization during the 2000s and early 2010s contributed to severe air pollution across many Chinese cities, particularly in northern industrial regions heavily reliant on coal-fired power generation and manufacturing activity.

By 2013, persistent smog events in Beijing had become a major public health concern and a global symbol of urban air pollution. During severe pollution episodes, PM2.5 concentrations in Beijing exceeded World Health Organization recommended levels by more than twenty times.(1) Major international news outlets frequently described the pollution events as an "Airpocalypse" as hazardous air quality disrupted schools, transportation, hospitals, and daily life across northern China.(2)(3)(4)

Pollution exposure was increasingly linked to elevated respiratory illness, cardiovascular disease, reduced life expectancy, and broader public health risks. Studies examining the January 2013 "Airpocalypse" found materially higher rates of respiratory and cardiovascular emergency visits during periods of extreme PM2.5 exposure.(5)

In response, China launched one of the world's largest air quality improvement campaigns. Policies included restricting coal consumption in major urban regions, tightening industrial emissions standards, expanding natural gas infrastructure, accelerating renewable energy deployment, and relocating or shutting down high-emitting industrial facilities.(6)

China's response also highlighted the scale of infrastructure investment often required to improve air quality in rapidly industrializing economies. Expanding natural gas networks, modernizing industrial facilities,

upgrading power systems, and deploying cleaner technologies required significant capital investment and long-term policy coordination. The experience demonstrated that meaningful air-quality improvements are closely tied to broader energy system modernization and infrastructure development.

Between 2013 and 2021, Beijing's average PM2.5 concentrations declined from approximately 89.5 μg/m³ to roughly 33 μg/m³.(6) While China remains the world's largest coal consumer, the country's large-scale air quality initiatives demonstrated how public health concerns can rapidly accelerate environmental policy, infrastructure investment, and energy system transition efforts.

(1) World Health Organization (2021), WHO Global Air Quality Guidelines; University of Chicago, Air Quality Life Index (AQLI).
(2) CBS News (2015), "China Air Pollution: Smog 'Red Alert' During Beijing 'Airpocalypse.'"
(3) Council on Foreign Relations (CFR) (2025), "China's Environmental Crisis."
(4) BBC News (2016), "China Smog: Beijing Issues First Ever 'Red Alert.'"
(5) Ferreri, J.M. et al. (2019), "The January 2013 Beijing 'Airpocalypse' and its Acute Effects on Emergency and Outpatient Visits at a Beijing Hospital," Environmental Monitoring and Assessment.
(6) Ministry of Ecology and Environment of the People's Republic of China, air quality and PM2.5 reporting data.

PILLAR 3

Climate – Long-term Dimension of Energy Cleanliness

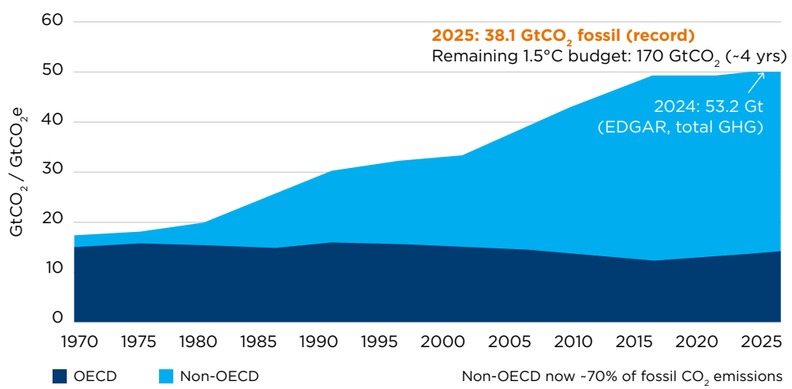
Reducing climate impacts requires decarbonizing with pragmatism

Climate cleanliness, the reduction of greenhouse gases such as CO_2 and methane, is essential for long-term climate stability, but it must be pursued in ways that keep energy available, affordable, and reliable. Climate strategies that rely too heavily on costly or immature technologies risk slowing economic development, raising energy prices, and undermining public support. A pragmatic approach focuses on reducing emissions per unit of useful energy using the most impactful and cost-effective tools first while strengthening – not weakening – the systems that keep modern life running.

The Science: Emissions Are Still Rising

Despite decades of climate diplomacy and accelerating investment in lower-carbon technologies, global GHG emissions continue to rise. Total GHG emissions reached 53.2 $GtCO_2e$ in 2024, while fossil CO_2 emissions hit a record 38.1 $GtCO_2$.[1] Even after significant gains from efficiency improvements, solar deployment, coal-to-gas switching, and other abatement measures, emissions are still projected to remain materially above net-zero pathways through mid-century, implying warming above 2°C by the end of the century. Non-OECD economies now account for ~70% of fossil CO_2 emissions, with China alone contributing 29% of global GHG emissions.[2] Any credible decarbonization framework must therefore focus not only on reducing emissions, but on scaling affordable and reliable lower-carbon energy systems in the regions where emissions growth is occurring most rapidly.

ANNUAL GLOBAL CO_2 EMISSIONS, OECD VS. NON-OECD[3]
($GtCO_2$)



Seven Principles + Cost Curve = Pragmatic Execution

Significant progress on carbon reduction can be achieved by first establishing a set of core principles, as outlined in our 2025 Stakeholder Report and summarized below, and then pursuing the most cost-effective solutions, as illustrated by the carbon abatement cost curve presented in that report using Thunder Said Energy's detailed analysis as a starting point.

- **1. Reframe "energy transition" as "energy addition and decarbonization."** History shows no completed fuel transitions, only additions.
- **2. Address energy needs and climate goals concurrently.** The end goal is abundant, clean energy, not one at the expense of the other.
- **3. Consider the global impact of carbon reduction strategies. Avoid carbon leakage.** Emissions cuts must be capital efficient and not shift emissions to higher-intensity regions.
- **4. Focus on efficient, scalable carbon abatement strategies.** Pursue the most economical approaches first since resources are limited for most countries.
- **5. Utilize full-cycle economics to guide investment decisions.** Weigh lifecycle emissions, energy availability and reliability, and local and global impacts.
- **6. Tailor solutions to regional needs and challenges.** Energy security, infrastructure, social acceptance, and affordability vary by region.
- **7. Prioritize education and leadership.** Energy supply and climate change are complex and evolving; strong leadership and course corrections are essential.

Affordability means looking at the full carbon abatement cost curve and focusing on full-cycle reductions that also offer economic value. Since Quantum's 2025 report, the curve has moved in both directions. Goldman Sachs Carbonomics 2025 reports that the low end of the curve continues improving, with solar and battery storage costs declining further, while hard-to-abate sectors such as heavy industry and transport have become more expensive. These trends continue to support Quantum's view that cost-effective solutions should scale first, while pathways dependent on persistent subsidies, green premiums, or immature technologies remain difficult to scale economically.[4]

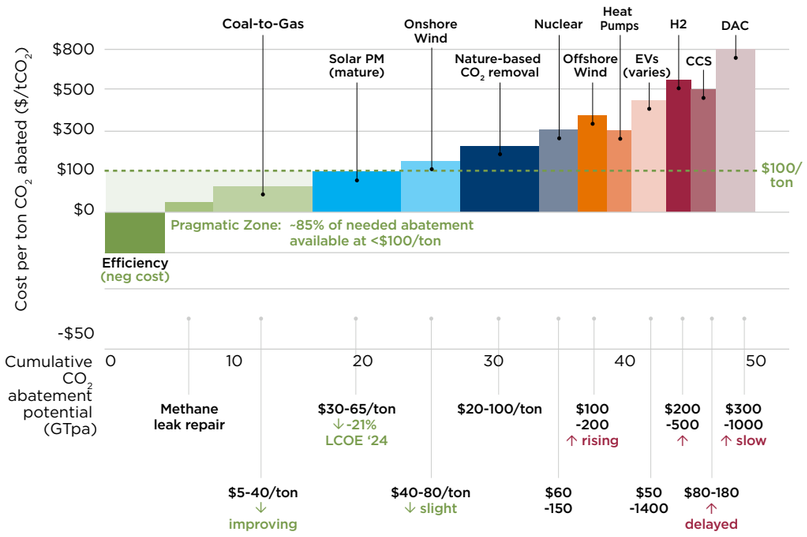
Cleanliness is Good Business

Cleanliness is not an abstract ideal; it is a practical driver of productivity and competitiveness. Investment in the global electricity sector reached approximately $1.5 trillion in 2025, roughly 50% higher than investment in oil, gas, and coal supply combined.[5] As outlined in previous reports, much of this spending has been inefficient and relatively uneconomic.

However, select activities at the lower end of the carbon abatement cost curve can offer compelling economic advantages. Energy efficiency, solar and wind in optimal locations, methane mitigation, coal-to-gas switching, and nature-based removals sit on the low- or negative-cost end of the abatement curve. Approximately 73 Gtpa of abatement is available at under $100 per ton, suggesting net zero may be achievable at a global average cost of approximately $40 per ton.[3] By contrast, the higher-cost tail of the curve – including CCS, offshore wind in less optimal locations, green hydrogen, first-generation DAC, and e-fuels – are pragmatically being delayed, resized, or canceled.

While it is rational to pursue the cheapest tons first, important questions remain regarding consistent global engagement, who pays for it, and competition with a wide range of other global priorities. Despite these uncertainties, cleanliness should remain an important part of the discussion when seeking optimal energy solutions.

GLOBAL MARGINAL CO_2 ABATEMENT COST CURVE – 2025[7]



(1) Friedlingstein et al. (2025), Global Carbon Budget 2025.
(2) Thunder Said Energy (2025), "Decarbonizing Global Energy: The Route to Net Zero" and Top Technologies database.
(3) JRC EDGAR (2025), EDGAR 2025 Report.
(4) Goldman Sachs (2025), "Carbonomics 2025."
(5) IEA (2025), World Energy Investment 2025.
(6) IEA (2025), Breakthrough Agenda Report 2025.
(7) Thunder Said Energy

PILLAR 3

The Canadian Dual Challenge Approach

A missed opportunity

CASE STUDY

Canada entered the 2015 Paris Agreement with a dual mandate: reduce domestic GHG emissions while sustaining growth in one of the world's most resource-rich economies. Over the following decade, Canada implemented carbon pricing, methane regulations, emissions caps, and more restrictive permitting requirements for hydrocarbon infrastructure.[1] Despite these efforts, emissions reductions remained modest while national productivity and investment growth lagged behind key peers during a period of rising global energy demand. Delays to Canadian LNG export development may have also limited opportunities to displace coal consumption in Asia, raising broader questions about the relationship between domestic climate policy, global emissions outcomes, long-term competitiveness, and unintended consequences.

The Canadian Climate Tradeoff

Between 2005 and 2024, Canada reduced domestic GHG emissions by approximately 10%, from roughly 759 $MTCO_2e$ to 685 $MTCO_2e$.[2] However, these reductions had little measurable impact on global emissions, which continued to rise materially over the same period, driven largely by growth in emerging markets and developing economies.[2] Unfortunately, many of the policies implemented to reduce GHG emissions coincided with a period of anemic economic growth, as Canada's real GDP per capita remained largely flat while U.S. real GDP per capita increased by approximately 18% since 2015.[3]

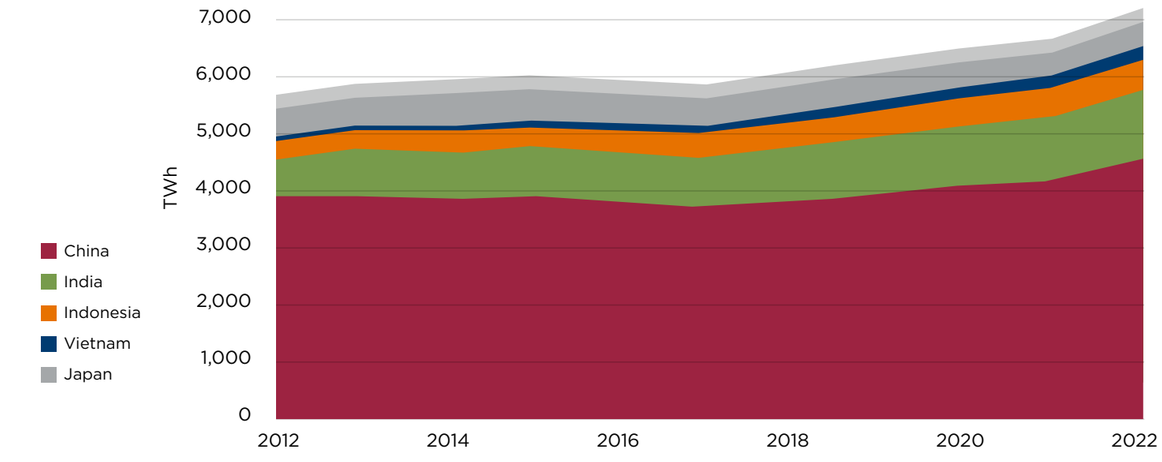
Impact on Canadian Resource Development and Emissions

Canadian oil and gas productivity growth lagged most OECD peers during the post-2015 climate policy era despite the country's significant natural resource base.[3] Business investment per worker declined relative to other economies, while capital increasingly shifted toward jurisdictions with shorter permitting timelines and more stable regulatory frameworks.[3] Canadian upstream oil and natural gas investment also remained well below pre-2014 levels despite recovering oil prices and rising LNG demand.[4]

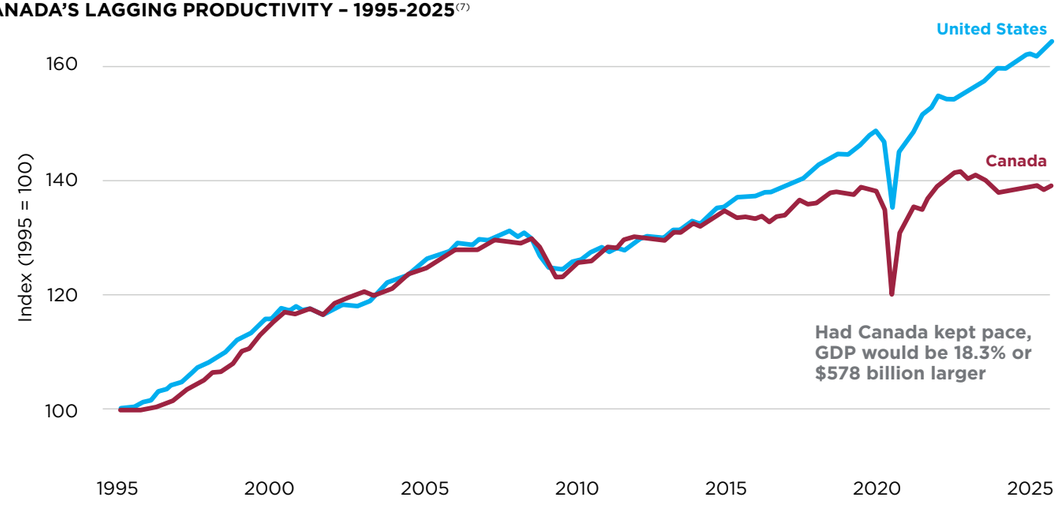
Regulatory complexity and prolonged approval timelines constrained Canadian LNG development while the U.S. rapidly expanded LNG export capacity and became the world's largest LNG exporter between 2016 and 2024.[4] By contrast, Canada's first major LNG export facility did not commence exports until mid-2025.[5] Meanwhile, coal consumption across Asia continued to rise despite growing LNG demand and significant renewable deployment. As a result, Canada may have missed an opportunity to contribute to global emissions reductions through LNG exports capable of displacing higher-emitting coal-fired generation.

Together, these outcomes highlight the complexity of climate policymaking. While Canada achieved measurable domestic emissions reductions, questions remain regarding economic competitiveness, resource development, and the extent to which domestic policy actions can influence global emissions outcomes in a rapidly growing and increasingly interconnected world.

ASIA COAL CONSUMPTION GROWTH – 2012-2022[6]



CANADA'S LAGGING PRODUCTIVITY – 1995-2025[7]



(1) Environment and Climate Change Canada (2024). National Inventory Report 1990–2024: Greenhouse Gas Sources and Sinks in Canada.
(2) IEA (2025). Greenhouse Gas Emissions Database; World Bank, World Development Indicators.
(3) Statistics Canada; OECD, Productivity Database; Federal Reserve Bank of St. Louis, Federal Reserve Economic Data (FRED).
(4) EIA (2025). U.S. LNG Export Capacity and Trade Data.
(5) LNG Canada (2025), project disclosures, company filings, and public construction updates.
(6) IEA (2022), Coal 2022, IEA, Paris.
(7) Tombe, T. (2025). A New Era for Canada's Economy? School of Public Policy, University of Calgary. Underlying data from Statistics Canada and Federal Reserve Bank of St. Louis (FRED).

PILLAR 3

Coal-to-Gas Switching and Methane Management

A realistic near-term approach to emissions reductions

CASE STUDY

Energy cleanliness is most durable when emissions reductions are driven by system-level improvements rather than policy-driven actions alone. Increasingly, global energy systems are shifting away from simplified "all-or-nothing" transition narratives toward more pragmatic approaches focused on balancing emissions reductions, reliability, affordability, resilience, and energy security.

Thunder Said Energy's global marginal abatement cost curves identify coal-to-gas switching and methane reduction among the largest and most economically attractive emissions reduction opportunities available today. Importantly, both pathways rely largely on commercially proven technologies, operational improvements, and existing infrastructure that can scale rapidly across the global energy system.[1]

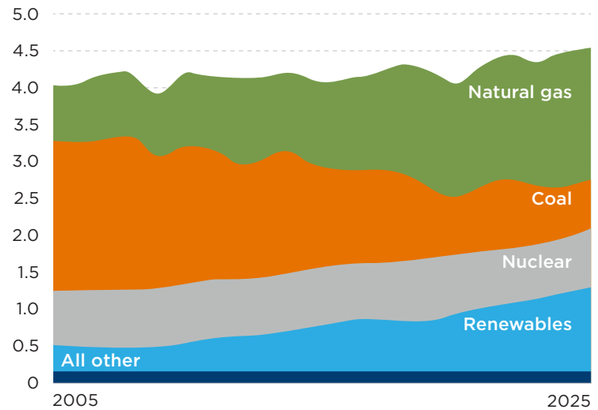
Coal-to-Gas Switching: Scalable, Low-cost Decarbonization

The U.S. coal-to-gas transition demonstrates how system-level energy improvements can reduce emissions while supporting affordability and reliability. Between 2005 and 2025, U.S. power-sector CO_2 emissions fell by roughly 40% even as electricity demand and GDP continued to grow, representing one of the largest emissions reductions achieved by any major economy during that period, driven primarily by coal-to-gas switching alongside continued growth in wind and solar generation.[2]

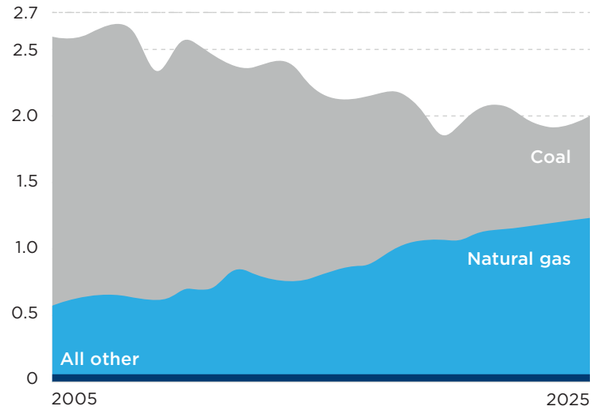
A key driver of this transition was the shale revolution, which unlocked abundant, low-cost natural gas and enabled gas-fired generation to displace coal across the U.S. power system. Because natural gas emits roughly 50–60% less CO_2 per kilowatt-hour than coal – and because modern combined-cycle gas plants operate more efficiently – the shift lowered emissions while improving grid flexibility and reliability. Multiple analyses estimate coal-to-gas switching accounted for more than half of U.S. power-sector CO_2 reductions since 2005.[3]

Thunder Said Energy estimates coal-to-gas switching worldwide could contribute roughly 6 $GtCO_2$ of annual global abatement by 2050 as coal's share of useful energy declines from approximately 29% to 8%. Gas-fired generation also provides flexible, dispatchable power that helps balance rising shares of wind and solar generation. The U.S. experience illustrates how cleanliness, abundance, and reliability can reinforce one another simultaneously.

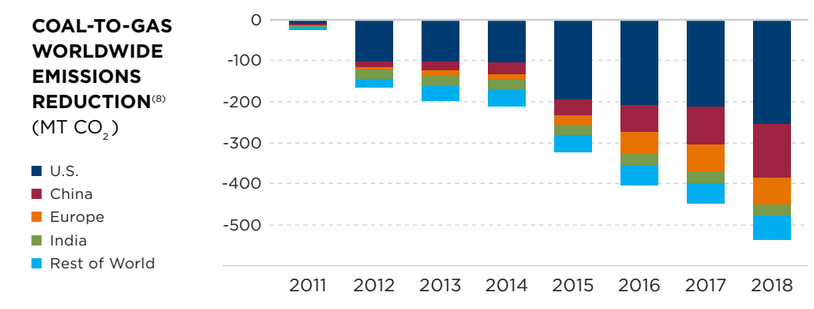
U.S. ELECTRICITY GENERATION[6]
(1,000 TWh)



U.S. CO_2 EMISSIONS[6]
(1,000 MMmt)



COAL-TO-GAS WORLDWIDE EMISSIONS REDUCTION[8]
(MT CO_2)



Methane Management: Immediate, High-ROI Emissions Reductions

Methane remains one of the highest-impact near-term opportunities to reduce emissions. It accounts for roughly 20–30% of global warming since the industrial era and is more than 80 times more potent than CO_2 over a 20-year period, making near-term reductions disproportionately impactful.[4]

The IEA estimates roughly 75% of methane emissions from fossil fuels can be reduced using existing technologies, with nearly half achievable at a net cost below $15–20 per ton CO_2e – placing methane reduction at the low-cost end of the global marginal abatement cost curve.[5]

The narrative surrounding hydrocarbons often assumes widespread leaky, high-flaring legacy operations. While these conditions still exist, they are increasingly concentrated among lagging operators rather than representative of the industry as a whole. A Thunder Said Energy dataset covering approximately 85% of U.S. onshore production in 2022 showed average upstream emissions intensity near 10 kg CO_2e per barrel of oil equivalent, with top performers below 3 and lagging operators above 70 – a more than 20x performance gap driven largely by methane leaks and flaring.[7] The data suggests emissions performance is increasingly determined by operational practices and infrastructure quality rather than hydrocarbons alone.

Industry-wide performance has also improved materially. Between 2015 and 2022, U.S. upstream methane emissions declined approximately 37%, while methane intensity fell roughly 57%, driven by improved LDAR, pneumatics replacement, equipment modernization, continuous monitoring technologies, and improved operational controls.

Conclusion: System-level Solutions are Durable and Scalable

Coal-to-gas switching and methane management demonstrate how scalable system-level improvements can reduce emissions while supporting affordability, reliability, and energy security. Rather than relying solely on future breakthrough technologies, these pathways use commercially mature technologies and operational improvements available today. For investors, the lesson is increasingly clear: decarbonization is most durable and scalable when it aligns with cost competitiveness, system reliability, and energy abundance.

(1) Thunder Said Energy, Global Marginal Abatement Cost Curves and Energy Transition Research, accessed May 2026.
(2) EIA (2026), Monthly Energy Review, Table 11.6.
(3) EIA, U.S. Energy-Related Carbon Dioxide Emissions and historical electricity generation data, accessed May 2026.
(4) IEA, Global Methane Tracker 2024, accessed May 2026.
(5) IEA, Methane Abatement in Fossil Fuel Operations, accessed May 2026.
(6) EIA (2021), "Electric Power Sector CO_2 Emissions Drop as Generation Mix Shifts from Coal to Natural Gas," Today in Energy.
(7) Thunder Said Energy, Methane Intensity and Upstream Emissions Benchmarking Research, accessed May 2026.
(8) IEA (2019), The Role of Gas in Today's Energy Transitions, World Energy Outlook Special Report.

A Pragmatic Approach to Improving the Human Condition

Abundance, reliability, and cleanliness are the key pillars to our energy future

Energy drives every other industry and underpins modern life and human prosperity. Ensuring the world has abundant (access and affordability), reliable (security and resilience), and clean energy is critical and can only be achieved by balancing all three pillars rather than overemphasizing any one objective. In a world where seven of eight billion people seek greater access to energy and technological advances such as AI are accelerating demand, energy systems have become strategic assets central to economic growth and quality of life. Recent geopolitical conflicts have reinforced this reality. By working together and pursuing an all-of-the-above approach, we can provide the energy needed to support continued human progress.

The energy challenge is becoming more complex as global demand continues to rise while much of the world's population still lacks the level of energy access enjoyed by the most developed economies. AI infrastructure, hyperscale data centers, electrification, population growth, and rising living standards across non-OECD economies are collectively increasing pressure on already constrained energy systems. Disruptions to global supply chains, including the conflicts in Ukraine and the Middle East, have added further strain. At the same time, many regions are confronting aging infrastructure, permitting challenges, and growing geopolitical disagreements over energy policy. These realities are reshaping how governments, operators, and investors evaluate energy systems and allocate capital. As discussed throughout this report, abundance, reliability, and cleanliness are all important, but how they are balanced will ultimately determine the success of future energy systems.

Growing Emphasis on Energy Security

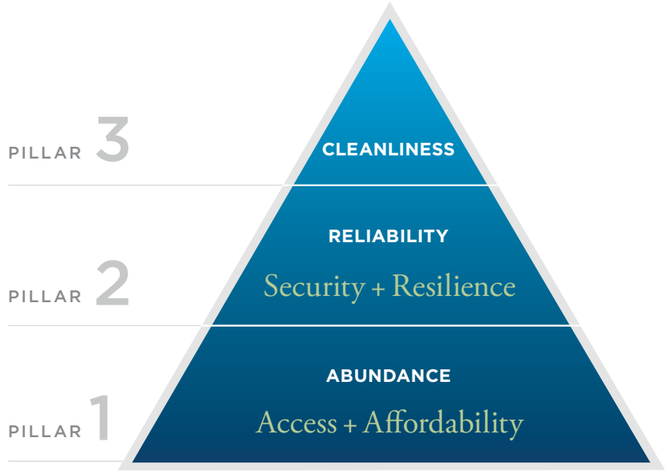
Russia's invasion of Ukraine in 2022 and the escalating conflict in the Middle East in 2026 exposed vulnerabilities in global energy supply chains and reinforced the strategic importance of secure and reliable energy systems. These disruptions are expected to influence future energy investment decisions, infrastructure development, supply chain relationships, and geopolitical alliances as governments and industries seek to strengthen resilience and reduce exposure to external shocks. In many respects, the current environment resembles the structural reset that followed the oil embargoes of the 1970s.

As a result, energy policy and capital allocation are increasingly shifting toward abundance, affordability, reliability, and national energy security, while emissions reduction has become one of several competing priorities. Economic growth, industrial competitiveness, and secure energy supplies are receiving renewed attention. Public, corporate, and governmental support for higher-cost climate obligations has weakened in many regions as affordability and reliability concerns have intensified. This shift reflects a growing recognition that prosperity depends on more than emissions reductions alone, particularly if abundance and reliability are compromised. The long-term implications remain uncertain, but energy systems are already evolving to address vulnerabilities that recent disruptions have exposed.

The Return of Energy Pragmatism

This shift in perspective – and the recognition that reliable energy and economic strength have an outsized influence on human prosperity – is well founded. The most scalable and impactful decarbonization pathways are increasingly those that align environmental progress with affordability and reliability. This dynamic is evident across the global carbon abatement cost curve. Lower-cost, operationally scalable solutions – including energy efficiency, methane mitigation, coal-to-gas switching, efficient renewable deployment, and infrastructure modernization – continue to gain traction because they deliver measurable emissions reductions while maintaining system reliability and economic viability.

The cost of carbon abatement matters. Higher-cost pathways that rely on sustained subsidies, create unintended consequences, or undermine broader economic objectives are likely to face greater implementation challenges. This does not mean climate considerations should be ignored. Rather, decision-making should incorporate full-cycle costs, system-wide impacts, economic outcomes, and broader implications for human well-being.



All-of-the-Above Needed to Meet Growing Energy Demand

There has never been an energy transition that fully replaced a prior energy source. Instead, history has been characterized by energy addition, as new technologies supplement existing sources to meet rising demand driven by population growth and economic development. This past year, the world consumed more coal, oil, and natural gas than at any point in history while simultaneously expanding renewable energy deployment and improving energy efficiency across virtually every sector.

Meeting future energy needs will require continued development of existing energy resources alongside investment in emerging technologies. Fossil fuels currently provide nearly 80% of global energy demand and have no viable near-term replacement at scale. Renewables – including wind, solar, and nuclear – are equally important, providing incremental supply while helping reduce emissions intensity. New technologies that increase energy availability, strengthen reliability, and lower emissions will also play an important role. Solutions that improve multiple dimensions of the energy system simultaneously are likely to scale more rapidly and sustainably than those dependent primarily on mandates or subsidies.

Energy Challenges Persist but Are Solvable

The challenges facing the global energy system are immense. Addressing energy poverty, supporting growing demand from AI and electrification, strengthening energy security, maintaining reliability, expanding infrastructure, and reducing emissions simultaneously is a daunting task. Yet history demonstrates that innovation, investment, and collaboration can overcome complex challenges.

By maintaining a practical framework, focusing on scalable solutions, and working together across industries and regions, the world can continue making meaningful progress toward a more abundant, reliable, and cleaner energy future. At Quantum, we are proud to play a role in that effort and remain optimistic about the opportunities ahead.

Our ESG Approach

Inside this section:

ESG Governance and Oversight

Responsibility for ESG at Quantum is shared broadly across the firm and embedded within how we govern, invest, and manage assets. Our ESG framework emphasizes active stewardship and disciplined oversight, supported by cross-functional coordination at the firm level and clear accountability within investment teams. This structure is designed to integrate ESG considerations into decision-making, promote transparency and accountability, and support long-term value creation.

Oversight of firmwide ESG priorities is provided by the ESG Steering Committee, which draws on deep collective experience evaluating material ESG factors across energy subsectors, geographies, and investment strategies. The Committee helps guide ESG priorities, promotes a consistent approach across teams, and facilitates the sharing of best practices across the firm. For each investment, deal teams are responsible for identifying, assessing, and managing material ESG risks and opportunities throughout the investment lifecycle, including during diligence, ownership, and exit planning.

Quantum's ESG Policy serves as the foundation for this approach, outlining expectations for responsible investment, operational sustainability, and ethical conduct. It informs how material ESG risks and opportunities – such as emissions management, resource efficiency, workforce practices, and community engagement – are evaluated, monitored, and addressed over time. Quantum believes this governance structure supports a practical, evolving approach to ESG integration aligned with Quantum's investment discipline and commitment to sustainable, long-term value creation.

Keila Diamond
Managing Director & Head of ESG

Wil VanLoh
Founder & CEO

Ajay Khurana
President

Charles Baillie
Partner & Chief Operating Officer

Garry Tanner
Partner

Jim Baird
Partner & General Counsel Emeritus

Roman Bejger
Partner & General Counsel

Michael Dalton
Partner & Co-Head of Client Solutions

Tom Field
Partner

Alan Smith
Operating Partner

Blake Webster
Partner

Patrick Hughes
Managing Director & Head of Global Government Affairs

Please see the Disclaimers at the end of this report for important information regarding ESG considerations in our investment practices.

ESG Governance Structure

Program Sponsorship

RESPONSIBLE TEAM: **Executive Team**

The Executive Team is responsible for providing overall sponsorship of the ESG program, seeking to ensure that it aligns with the company's core values and strategic goals. Their leadership helps drive the integration of ESG across all areas of the business.

Oversight, Strategic Guidance & Representation

RESPONSIBLE TEAMS: **ESG Steering Committee and Quantum Representatives on the Boarads of Portfolio Companies**

The ESG Steering Committee and Quantum representatives on portfolio company boards provide oversight and strategic guidance to Quantum and our portfolio companies, seeking to ensure that ESG initiatives are aligned with business objectives and regulatory requirements. They monitor progress and advocate for the integration of ESG principles at the highest levels of governance.

Strategy Development & Implementation Support

RESPONSIBLE TEAMS: **ESG Team, Transaction Team, Technical Team, Client Solutions Team, and Digital Team**

These teams collaborate to develop and support the implementation of ESG strategies across the portfolio. Each team brings its expertise to help ensure that ESG considerations are deeply embedded in all aspects of investment, technical operations, client engagement, and digital transformation.

Implementation

RESPONSIBLE TEAMS: **ESG Team and Portfolio Companies**

The ESG Team works directly with portfolio companies to implement ESG strategies, with an aim toa drive tangible actions and results. This includes working closely with company leadership to embed ESG best practices into daily operations and long-term planning.

ESG as a Capital Enabler

At Quantum, ESG is not viewed as a parallel objective to financial performance, but as a core input into investment discipline and capital outcomes. When applied with focus and materiality, we believe consideration of ESG risks and opportunities can serve as an enabler of risk-adjusted returns, operational resilience, and successful exits. Our approach is grounded in the belief that well-managed assets – those with strong governance, responsible operations, and durable stakeholder relationships – are better positioned to perform across market cycles and attract a broader universe of capital.

From an investment perspective, Quantum's ESG program supports value creation by strengthening license to operate and reducing downside risk. We believe effective management of material ESG factors helps protect cash flows, limit operational disruptions, and reduce exposure to regulatory, legal, and reputational risks. These considerations are particularly important in energy and infrastructure assets, where long asset lives, complex stakeholder dynamics, and evolving regulatory expectations can materially influence performance and valuation. By embedding ESG considerations into diligence, ownership, and exit planning, Quantum seeks to enhance predictability, resilience, and exit readiness.

We also believe that ESG factors can play an increasingly important role in preparing portfolio companies for future capital markets and buyer expectations. Institutional investors, strategic acquirers, and infrastructure buyers – particularly in Europe and Asia – are placing greater emphasis on transparency, governance quality, emissions management, and social performance as part of their underwriting and allocation decisions. Assets that demonstrate credible ESG practices and data-driven performance are often better positioned to access capital, attract strategic partners, and achieve favorable exit outcomes.

Quantum views ESG as a capital enabler and approaches it with a practical, forward-looking mindset. We focus on the ESG factors most relevant to enterprise value and align our practices with global investor expectations, positioning our investments for long-term relevance, broader capital access, and durable value creation.

SPOTLIGHT

Antero Resources Acquires HG Energy II

In December 2025, Antero Resources announced a purchase agreement to acquire Quantum's HG Energy II, a West Virginia-based Marcellus producer, for a total consideration of $2.8 billion. HG is an oil and gas exploration company operating in the Appalachian Basin, with a focus on producing clean-burning natural gas. The company has been a top ESG performer within Quantum's portfolio and among U.S. producers for several years. In a 2022 benchmarking study conducted by Ceres and Environmental Resources Management (ERM), HG was ranked as having the second-lowest methane intensity in the country.

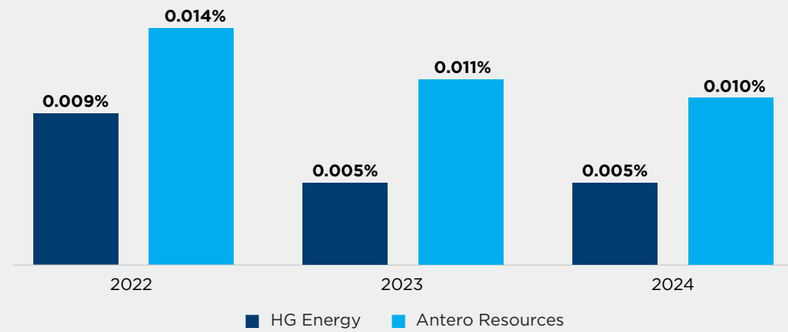
During Quantum's ownership, the HG team implemented several projects that decreased emissions and improved operational efficiency, enabling them to align with the high-performing operators in the region. Starting in 2022, the company began installing instrument air packages on all new facilities, curbing methane emissions and saving natural gas that would otherwise be emitted from pneumatic actuators. In 2024, HG began utilizing an electric frac fleet, with power generated by onsite natural gas produced by HG. This initiative lowered operating costs and reduced emissions, saving approximately ~$7.5 million per year by displacing costly, emissions heavy diesel fuel. This practical approach, where HG identified and executed a series of high value ESG projects, supported their exit readiness.

"HG built a culture of operational discipline and continuous improvement, pairing efficiency gains with a strong ESG track record. While transactions are driven by many factors, those qualities position a company to resonate with any strategic buyer – particularly one like Antero, whose ESG standards are both rigorous and clearly defined."

Jonathan Ragan,
Partner

Antero Resources is a leader in responsible energy and is committed to striving for the highest ESG standards. Antero's ESG program is anchored by measurable goals, including a target to achieve net-zero Scope 1 and Scope 2 GHG emissions, and a methane leak loss rate of 0.025%. We believe Antero recognized the value of HG's robust ESG foundation, which aligns closely with Antero's established ESG objectives.

PRODUCTION SEGMENT
SCOPE 1 METHANE LEAK RATE[1]
(Percent methane emitted/methane produced)



(1) HG internal calculations, Antero Resources 2024 ESG Report.

Materiality Mapping

To focus our ESG efforts where they can most directly influence performance, Quantum conducts a materiality mapping process designed to identify ESG factors most relevant to enterprise value across our investments. Rather than treating ESG as a standalone exercise, this process focuses on issues with the potential to affect cash flows, risk exposure, operational resilience, and exit outcomes at both the firm and portfolio levels.

Our materiality mapping integrates internal insight with external benchmarks to support disciplined decision-making. We assess ESG priorities against leading global frameworks – including the Sustainability Accounting Standards Board (SASB), the Task Force on Climate-related Financial Disclosures (TCFD), the Global Reporting Initiative (GRI), and the Institutional Limited Partners Association (ILPA) – while incorporating input from Quantum leadership, investment teams, portfolio company representatives, and external stakeholders. This analysis helps identify ESG factors most likely to influence operational performance and regulatory exposure over the investment lifecycle.

The results of this process inform how we allocate management attention and capital across the portfolio. Quantum supports portfolio companies with guidance and tools to actively manage material ESG factors, focusing on initiatives that strengthen cash-flow durability, reduce downside risk, and improve strategic positioning. These considerations are integrated throughout diligence, ownership, and exit planning.

Linking Material ESG Factors to Enterprise Value

ESG PILLAR	FOCUS AREA	KEY FACTORS	ENTERPRISE VALUE LENS	VALUE IMPACT
ENVIRONMENTAL	**Climate Change** Minimizing emissions and managing climate-related risks	GHG Emissions (Scopes 1 & 2): methane, flaring, combustion GHG Emissions (Scope 3) Climate resilience	• Protects operating margins by managing emissions-related costs and regulatory exposure • Supports asset resilience and reliability under physical and transition risks • Strengthens market access and commercial positioning	Cash flow durability Risk mitigation Exit readiness
	Natural Resources & Releases Responsible stewardship of land, water, and other natural resources	Biodiversity & habitat Air emissions Water consumption Wastewater Waste Spill prevention Well closure & site decommissioning	• Reduces risk of unplanned downtime, remediation costs, and asset impairment • Supports regulatory compliance and permit continuity • Preserves long-term asset utility and operational flexibility	Downside protection Asset longevity Regulatory certainty
SOCIAL	**Human Capital** Keeping employees safe and prioritizing their well-being	Health & safety Labor standards & human rights Asset integrity & process safety Human capital management	• Protects productivity and operating performance by reducing injuries, turnover, and workforce disruption • Supports talent attraction, retention, and leadership continuity • Enhances operational reliability through a skilled, engaged workforce	Operational continuity Workforce stability Long-term performance
	Community Relations Supporting stakeholders, including communities where we operate	Community engagement Indigenous Peoples & First Nation rights Land acquisition, use & resettlement	• Preserves license to operate through trust and constructive community relationships • Reduces risk of project delays, opposition, or operational disruption • Supports long-term asset performance and expansion opportunities	License to operate Reputational strength Operational stability
GOVERNANCE	**Corporate Ethics & Governance** Increasing accountability and transparency, and upholding ethical standards	ESG performance monitoring Stakeholder engagement Business ethics & code of conduct Cybersecurity Executive incentives tied to ESG performance	• Mitigates legal, regulatory, and reputational risk • Supports investor confidence, capital access, and transaction readiness • Enhances oversight, decision-making quality, and alignment between management and owners	Risk mitigation Capital access Exit readiness

ESG Integration

Quantum seeks to integrate ESG considerations across the full investment lifecycle, while tailoring application to the specific risks, opportunities, and value drivers of each investment strategy. This approach allows for consistency in governance and discipline, while recognizing that material ESG factors – and their impact on enterprise value – vary meaningfully across asset classes.

ESG Integration in the Investment Life Cycle[1][2]

	Deal Sourcing	Pre-Investment: Thorough analysis, review, & approval			Post-Investment: Active ownership, engagement, & realization	
		Deal Lifecycle	Due Diligence	Investment Decision	Ownership & Stewardship	Exit
ESG Objectives		**Minimize exposures that conflict with Quantum's risk-adjusted return expectations**	**Identify material ESG risks and opportunities**	**Invest and integrate material ESG analysis**	**Steward active investments**	**Influence through results and engagement**
ESG Integration		Assess new opportunities for alignment with Quantum and investor criteria	Evaluate material liabilities, risks, and opportunities through the lens of Quantum's material ESG factors	Consider the valuation of ESG performance when making the final investment decision	Work with portfolio companies to implement key initiatives and continuously seek to mitigate regulatory risks	Communicate value added and potential future upside to potential buyers

ESG Integration by Investment Type

Upstream Oil and Gas

In upstream investments, ESG integration is closely tied to operational performance, regulatory exposure, and asset longevity. Investment teams focus on factors such as operational efficiency, methane management, safety performance, and evolving regulatory requirements during due diligence and ownership. These considerations inform valuation, capital allocation, and development planning, with an emphasis on protecting cash flows, reducing downside risk, and supporting exit readiness.

Infrastructure

For infrastructure assets, ESG integration emphasizes reliability, workforce stability, and long-term system resilience. During diligence and ownership, teams assess asset integrity, operational continuity, workforce practices, and exposure to regulatory or grid-related risks. Given the long-lived nature of these assets, material ESG considerations play an important role in supporting predictable performance, contractual stability, and attractiveness to strategic buyers.

Credit

Within Quantum's credit strategy, ESG integration is applied through a risk and underwriting lens. These considerations inform covenant design, structuring, pricing, and ongoing monitoring. They also support downside protection and appropriate compensation for risk throughout the life of the investment.

Venture

In venture investments, ESG integration focuses on responsible scale-up and long-term viability. Teams consider governance foundations, regulatory readiness, workforce practices, and environmental impacts as companies grow. Material ESG considerations are integrated to help early-stage businesses build resilient operating models, anticipate future stakeholder expectations, and scale in ways that support effective risk management.

(1) Although Quantum considers our ESG strategy to be an opportunity to improve performance and avoid risk for our investments, Quantum cannot guarantee that our strategy will positively impact financial or climate performance of any individual portfolio company. Please see the Disclaimers at the end of this report for important information regarding ESG considerations in our investment practices.
(2) As Quantum deems feasible and appropriate, Quantum's investment professionals will integrate material ESG factors into the investment process by implementing some or all of the above example practices.

ESG Integration

Deal Sourcing, Due Diligence, & Decision Making

At Quantum Capital Group, material ESG considerations are integrated early in the investment process to inform how opportunities are evaluated from the outset. ESG and investment teams work closely during sourcing and due diligence to identify material ESG risks and opportunities that may influence valuation, execution, and long-term value creation. This early integration helps ensure ESG factors are considered alongside commercial, operational, and financial inputs when investment decisions are made.

The depth and application of ESG analysis are tailored to the investment structure and Quantum's level of influence. In situations where Quantum has limited control – such as minority positions or investments with restricted access – our approach focuses on what is practical and appropriate. This can include a review of publicly available information, benchmarking, and direct engagement with management teams to assess governance practices and alignment with Quantum's investment philosophy. Where Quantum has greater influence or operational control, we conduct more detailed ESG diligence. We may engage external specialists to support risk assessments and the development of targeted action plans. This flexible approach allows ESG considerations to be applied consistently while remaining proportionate to each investment's structure and risk profile.

Due Diligence Goals and Key Steps

Understand Commitment Level

- Engage management teams to assess their oversight of material ESG risks.
- Evaluate ESG teams to understand their capacity for managing sustainability challenges and delivering on ESG priorities.

Analyze Historical ESG Performance

- Review key ESG documents, policies, permits, and historical data to assess the company's performance over time.
- Engage third-party consultants, where appropriate, to provide expert analysis and validate internal reporting.
- Conduct site visits, where appropriate, to gain direct insight into operational practices and associated risks.

Assess ESG Factors and Seek to Reduce Risk/Create Value

- Identify and quantify material ESG risks.
- Map material ESG risks and opportunities to action plans designed to mitigate downside exposure and enhance long-term value.
- Summarize key findings and present action plans to Quantum's Investment Committee.

Execute on ESG Opportunities

- Partner with deal teams and portfolio companies to implement identified action plans.
- Leverage ESG data to uncover and drive additional value-creation projects.

Ownership & Stewardship

During the investment period, we work side by side with our portfolio companies to advance key ESG initiatives that help manage risks and unlock value. From the outset of each partnership, we take an active, collaborative approach. We serve as a hands-on resource to management teams as they navigate material ESG considerations relevant to their operations and strategy.

We also support portfolio companies by providing ESG tools, best practices, and practical guidance. This includes standardized internal processes and reporting frameworks that provide a foundation for strengthening ESG practices under Quantum's ownership. Building on insights identified during deal screening and due diligence, we tailor our engagement to each company's specific context. We work alongside management to improve operational performance, enhance resilience, and position the business for durable outcomes over time, including increased attractiveness at exit.

Engagement During Ownership & Stewardship Phase

Onboarding

- Conduct strategic planning sessions with portfolio leadership to address issues identified during due diligence, develop clear ESG action plans, and align priorities for implementation.

Quarterly Working Group Meetings

- Convene quarterly cross-portfolio meetings to share ESG insights, discuss challenges, exchange best practices, and foster a collaborative learning environment.

Resources and Reporting

- Provide a robust suite of ESG tools, resources, and templates – including quarterly ESG surveys and Board reporting materials – to help companies monitor progress and drive continuous improvement.

Regulatory Information Sessions

- Engage legal, environmental, and regulatory experts to deliver targeted briefings, keeping portfolio companies informed on evolving regulations and emerging ESG risks.

Check-ins

- Conduct regular one-on-one meetings with designated ESG coordinators from each portfolio company to review progress, address roadblocks, and offer tailored strategic and operational support.

Strategic Partnerships

- Help portfolio companies identify and connect with leading third-party experts in areas such as monitoring, emissions reductions, and ESG data services to accelerate key initiatives and strengthen outcomes.

ESG Integration

Monitoring, Evaluation, & Reporting

To effectively deliver on our ESG program, we work to collect a comprehensive range of data across our portfolio through a rigorous monitoring and reporting process. Our data collection efforts are a foundational element of how we engage with portfolio companies and form a core part of our collaborative approach. By analyzing these data points, we are able to spot emerging trends, evaluate risks and opportunities, and design targeted action plans to help address key issues. We report ESG performance proactively and transparently across multiple channels to help make our disclosures clear, comparable, and meaningful to stakeholders. In addition, we seek to maintain regular dialogue with investors and other stakeholders to gather input and help keep our reporting aligned with evolving expectations and informational needs.

Portfolio Company Reporting Process

Quarterly Surveys

Used to identify trends, highlight key risks or issues, and align with Quantum's ESG policies and expectations.

Annual Surveys

Used to capture detailed, year-over-year data, providing a comprehensive view of progress and challenges.

Quarterly Board Reports

Portfolio companies use a standardized Quantum reporting template to brief their Boards on ESG progress, key initiatives, and long-term performance trends.

Unplanned Events

Portfolio companies must promptly report material incidents or events, and Quantum supports mitigation efforts.

ESG Data Metrics[1]

CATEGORY	TYPES OF METRICS MONITORED
Energy Consumption	Electricity consumption / Fuel consumption
GHG Emissions	Scope 1 / Scope 2 / Gas flaring
Methane	Methane intensity and LDAR / Methane reduction
Air Emissions	Number of Title V facilities / Criteria pollutants
Water	Total fresh / Non-freshwater sourced / Recycled water
Spills	Oil spills / Water spills / Chemical spills
Safety, Contractor, Vehicle	Work hours / TRIR / LTIR / PVIR / Lost time incidents
Regulatory Compliance	Notice of Violations (NOVs) and associated fines
Anonymous Reporting	Presence of systems in place
Community Relations	Number and type of complaints
Human Capital Management	Employee turnover and demographics

(1) Reporting processes apply to select companies with relevant data available. Not all Quantum companies, including partially owned companies, or non-traditional oil and gas companies, are required to report on all metrics.

Supporting Exit Values

We believe that portfolio companies with a strong ESG track record are more attractive to buyers because they offer greater resilience, lower risk exposure, and stronger long-term value creation potential. By integrating ESG considerations throughout the ownership phase, we believe we help position our companies not only for operational success but also for a more compelling, higher-value exit.

As part of the exit process, we work closely with our operated, majority-owned portfolio companies to prepare credible and comprehensive ESG materials. These materials are designed to meet listing requirements and provide prospective buyers with the ESG information they need to evaluate risk, performance, and long-term value. We assist in responding to potential investors' questions by compiling clear, verifiable ESG data that highlights business improvements, risk mitigation efforts, and sustainability achievements under Quantum's ownership. Additionally, we focus on strengthening each company's ESG management system so it is self-sustaining and robust. We believe this helps safeguard against reputational or operational risks after exit and helps the company remain well positioned for long-term success under new ownership.

Engagement During Exit Phase

Identify High-Impact Projects for Potential Buyers

We collaborate with companies to identify what we believe are high-impact ESG initiatives that appeal to potential like-minded buyers, with the intent to make the company more attractive at exit.

Highlight ESG Progress and Compile Relevant Data

We help our portfolio companies gather and present ESG data that showcases the positive business improvements achieved over time. This information gives prospective buyers insights into the company's ability to deliver value through its ESG initiatives.

Seek to Ensure Self-Sustaining ESG Systems Post-Exit

To ensure a smooth transition post-exit, we aim to help companies develop self-sustaining ESG management systems that can operate independently.

Managing Climate-Related Risks

Inside this section:

Climate Approach & Strategy

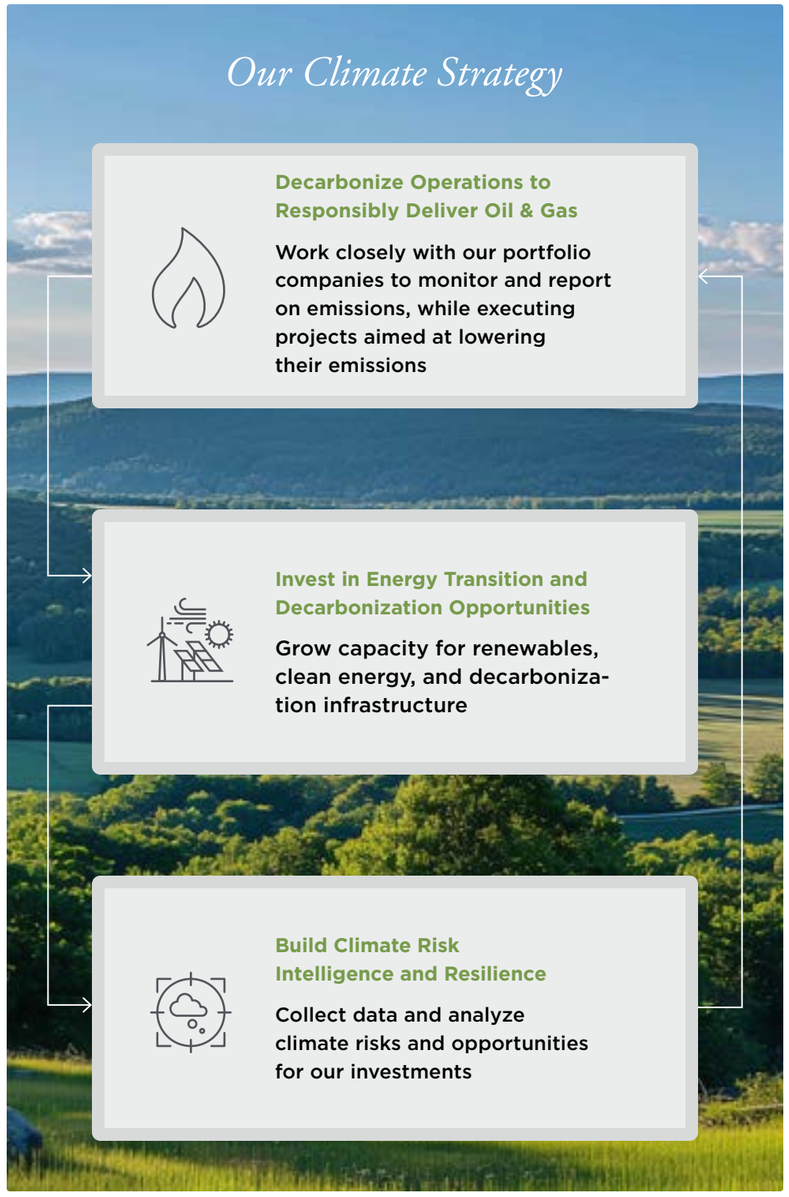
Quantum approaches climate considerations through a pragmatic, supply-first lens that recognizes the essential role of reliable, affordable energy in supporting economic growth, energy security, and global development. We believe that durable emissions reductions are achieved most effectively when decarbonization solutions are aligned with market fundamentals, technological feasibility, and system reliability – rather than through approaches that prioritize targets without regard to real-world constraints.

Climate Approach: Supply-First, Market-Led Decarbonization

Our climate positioning reflects the view that energy demand will continue to grow for decades, driven by population growth, industrialization, electrification, and emerging technologies such as artificial intelligence. In this context, meaningful climate progress depends on improving the emissions intensity of energy supply, scaling proven technologies, and investing in infrastructure that enables lower-carbon outcomes while maintaining reliability and affordability. Quantum therefore focuses on opportunities that reduce emissions per unit of energy produced or delivered, rather than pursuing decarbonization pathways that risk supply disruption or economic inefficiency.

A market-led approach is central to this philosophy. We prioritize initiatives where emissions reductions are supported by economics, operational improvements, and customer demand – creating incentives for adoption that can scale over time. This includes initiatives in efficiency improvements, infrastructure modernization, lower-carbon fuels, and technologies that enhance system performance and resilience. We believe solutions that compete on cost, reliability, and performance are more likely to deliver sustained emissions reductions than those reliant on policy support alone.

This pragmatic climate framework is embedded within Quantum's broader risk management and investment framework. Climate-related risks and opportunities are evaluated alongside other material ESG and financial considerations, informing investment decisions, asset management strategies, and exit positioning. By balancing climate objectives with energy security and market realities, Quantum seeks to support practical decarbonization pathways that protect capital, enhance asset resilience, and contribute to long-term value creation.



Climate Strategy Management Steps

We have implemented a structured approach to manage current and emerging climate-related risks and opportunities. This approach helps us integrate climate considerations across our operations and decision-making processes.

1

Calculate carbon footprint – Since Quantum does not generate significant operational GHG emissions at a firm level, we calculate our annual financed emissions to understand our indirect environmental impact.

2

Assess risks – We have identified representative transitional risks and opportunities using two climate scenarios and evaluated the physical risks of three portfolio companies that we believe are geographically representative of future investments.

3

Disclose results – We disclose our emissions data each year and seek to align our disclosures with the recommendations of the TCFD. See page 67 for additional information.

4

Create operational targets – We developed goals for oil and gas operators that we believe align with industry best practices to reduce GHG emissions. To learn more, see page 56.

Decarbonizing Operations to Responsibly Deliver Oil and Gas

A key component of our climate strategy is decarbonizing operations so we can responsibly produce and deliver oil and gas without compromising energy supply. As part of that effort, we have developed aspirational operational goals for our portfolio companies to help manage and reduce their Scopes 1 and 2 GHG emissions. With these goals serving as a potential roadmap, our portfolio companies can improve operational efficiency, increase revenue by capturing and monetizing more gas, and proactively prepare for possible future regulatory requirements in furtherance of our objective to enhance their value.

Operational Emissions Goals[1]

1 Methane Emissions

Quantum recommends the below methane intensity caps to our portfolio companies:

Aim to achieve or maintain a methane intensity below 0.20% for the upstream segment[2]

Aim to achieve or maintain a methane intensity below 0.024% for the midstream segment[2]

2 Direct Measurement

Direct detection of methane leaks results in more accurate methane emissions data and allows operators to quickly identify problems and implement leak reduction strategies. Hence, Quantum recommends that portfolio companies:

Implement direct detection and measurement of methane emissions using on-the-ground direct measurement and continuous monitoring sensors

3 Flaring

In line with the World Bank Zero Routine Flaring Initiative adopted by many leading oil and gas companies, Quantum recommends that portfolio companies:

End routine flaring by 2030

Aim to keep flaring intensity below 1%[3]

4 CO_2 Emissions from Fuel Consumption

Quantum recommends that portfolio companies:

Strive to reduce Scope 1 CO_2 emissions from fuel combustion in operations by 50% by 2030[4]

5 Scope 2 Emissions

To reduce Scope 2 emissions from electricity used in drilling, completion, and production, where possible, Quantum recommends that portfolio companies:

Strive to procure 100% renewable electricity by 2030

Where renewable electricity is not available, use Renewable Energy Credits (RECs), in alignment with Scope 2 GHG Protocol offsetting guidance

SCOPE 1 | **SCOPE 2**

Please see disclosures for important information regarding ESG considerations of our investment practices.

(1) Targets are non-binding, and no assurance can be given that targets will be achieved by portfolio companies.

(2) Methane intensity is calculated as methane emissions allocated to the natural gas value chain divided by the methane throughput, following the approach established by the Natural Gas Sustainability Initiative (NGSI) Methane Intensity Protocol.

(3) Flaring intensity is calculated as the percent of produced gas that is flared.

(4) New companies coming into the portfolio will aim to reduce fuel consumption according to the baseline calculated in their GHG footprint during acquisition.

Climate Risk Assessment

To better understand how climate-related factors may influence portfolio performance, Quantum conducts periodic assessments to evaluate potential exposures across a range of market and policy scenarios.

Climate Risk Assessment Strategy and Purpose

Quantum's climate risk assessments are designed to strengthen investment decision-making, enhance risk visibility, and promote portfolio resilience across a range of plausible future market and policy environments. Climate-related factors increasingly influence regulation, customer behavior, capital allocation, and asset valuation. Understanding how these risks may affect portfolio companies is critical to protecting downside risk and supporting long-term value creation. In 2025, Quantum completed a climate risk assessment with portfolio company Risilience to quantify the potential financial impacts of both transition risks – including policy, market demand, and litigation – and physical risks related to acute weather events.

Assessment Design and Methodology

The analysis applied Network for Greening the Financial System (NGFS) Phase V climate scenarios, which are widely used by financial institutions and regulators to model a range of potential climate and economic futures. These scenarios span current policy trajectories, delayed and fragmented transitions, and more ambitious decarbonization pathways, including a Net Zero 2050 scenario. While certain scenarios may be more likely in the near term given current geopolitical and policy dynamics, higher-ambition pathways were included to stress-test the portfolio and support alignment with evolving disclosure expectations, including TCFD and International Financial Reporting Standards Disclosure Standard 2 (IFRS S2).

Portfolio company data was used to construct financial and emissions "digital twins" for each asset. These models project revenues, emissions, and cash flows under business-as-usual assumptions and then apply climate risk factors to quantify potential impacts over a defined time horizon. Financial impacts are expressed as changes in discounted cash flow relative to baseline projections.

The assessment focused on the period from 2025 to 2028, reflecting Quantum's typical investment horizon and providing actionable insights relevant to near- and medium-term decision-making. While scenario pathways diverge more meaningfully over longer timeframes, this approach allows us to evaluate climate risks in a way that we believe is consistent with underwriting, asset management, and exit planning.

How the Results are Used

The results of the climate risk assessment provide a structured view of where potential exposures are concentrated across the portfolio and how different risk drivers may evolve under varying market and policy conditions. The analysis highlights the relative significance of policy-driven carbon pricing risk, the sensitivity of certain assets to macroeconomic demand shifts, and the comparatively lower near-term financial exposure from litigation risk. It also identifies areas where physical climate impacts may influence operational performance, including asset-specific exposure to weather-related disruptions.

Importantly, the assessment reinforces Quantum's view that climate risk is not a single variable, but a set of interrelated factors that can affect asset performance, cost structures, and exit valuations. The findings are used to inform investment screening, valuation assumptions, engagement priorities, and risk mitigation strategies at the portfolio company level. They also support ongoing integration of climate considerations into enterprise risk management and firmwide ESG governance.

Key 2025 Assessment Findings

Policy-driven carbon pricing represents the most significant climate-related financial risk under higher-ambition decarbonization scenarios. This is due to its direct link to emissions intensity, asset location, and growth assumptions. While widespread federal carbon pricing in the U.S. is not expected in the foreseeable future, this risk becomes material under scenarios that assume accelerated policy action or regulatory convergence.

Market demand risk reflects macroeconomic shifts in energy consumption rather than asset-specific dynamics. The impacts are relatively consistent across the portfolio due to sector concentration. These risks tend to emerge more gradually and are closely tied to broader economic and transition pathways.

Climate-related litigation risk is currently assessed as limited over the modeled period, reflecting the portfolio's relative market position and predominantly business-to-business operating models.

Physical climate risks are asset- and geography-specific, with certain exposures offset by reduced weather-related disruptions in some regions over the assessment horizon.

Technology transition and reputational risks represent longer-term considerations that may influence asset valuations beyond Quantum's typical investment horizon. This reinforces the importance of disciplined underwriting and exit planning.

Overall, the assessment highlights that climate risk is highly scenario-dependent, underscoring the value of stress testing assets against a range of future states rather than relying on a single expected outcome.

Risilience

Our climate risk assessment partner

CASE STUDY

	PRIMARY OFFICE	YEAR OF INVESTMENT
Risilience	Cambridge, England	2022
	Risilience empowers global finance, sustainability, and risk teams to quantify, plan, and act on the financial impacts of climate risks, driving transformation and competitive advantage in a lower-carbon economy.	

Risilience is a Quantum Innovation Fund (QIF) climate intelligence portfolio company focused on translating climate-related risks into decision-useful financial insights for investors and businesses. Its award-winning software platform combines climate science, economic modeling, and company-specific data to help organizations understand how climate dynamics may affect asset performance, strategy, and long-term value. In 2025, Quantum partnered with Risilience to assess climate risks and opportunities within our portfolio.

Risilience's platform, Riise, aims to quantify the potential financial impacts of climate- and nature-related risks. It enables teams across an organization to understand how these factors may influence costs, revenues, and asset performance over time. The platform evaluates physical, transition, and nature risks through a single analytical framework. This helps convert complex climate data into actionable insights for investment and operational decision-making.

At the core of the platform is digital twin modeling. Riise models companies and assets in financial terms and stress-tests them across climate and economic scenarios. By linking emissions profiles, operating assumptions, and financial forecasts, it shows how policy shifts, market changes, and physical hazards may affect cash flow and valuation. This allows climate risk to be evaluated alongside traditional financial and operational considerations.

Beyond analytics, Risilience supports organizations in navigating evolving disclosure and regulatory expectations. Its tools align with leading global frameworks and support audit-ready analysis. Together, these capabilities help strengthen risk management, inform investment decisions, and position assets for long-term resilience.

Risilience's approach is grounded in scientific research developed with the Centre for Risk Studies at the University of Cambridge Judge Business School. These frameworks, combined with financial modeling and sector expertise, help translate climate dynamics into insights that are relevant for underwriting, asset management, and exit planning.

> *"Scenario analysis allows us to better understand the impact of climate change and how it could affect our company. It is a critical tool for strategic and financial planning and risk management."*
>
> **Nestlé CDP Corporate questionnaire 2024**
> P156

Nestlé

> *"We partner with Risilience, a specialised climate analytics company which uses technology pioneered by the Centre for risk Studies at the University of Cambridge Judge Business School, to co-develop a digital twin platform, enabling the modeling of both physical and transition risks across our value chain over a 20 to 30-year time horizon."*
>
> **CCEP**
> P37, Annual Report 2024

Coca-Cola

> *"Our approach to understanding climate-related risks and opportunities is underpinned by scenario analysis. Climate and enterprise analytics technology (developed by the Cambridge-based consultancy Risilience and built on research and frameworks pioneered by Cambridge Centre for risk Studies) provides quantitative analytics that inform risk management and decision-making across the Group."*
>
> **Reckitt**
> P218, Annual Report 2024

reckitt

Portfolio ESG Performance and Accountability

Inside this section:

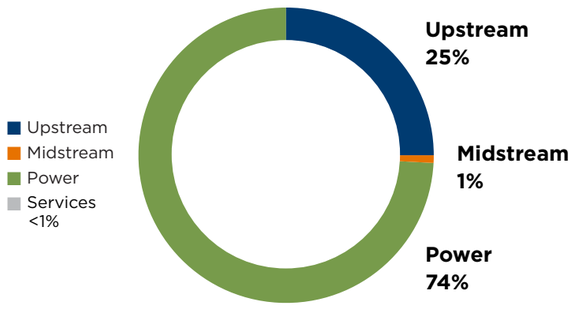
Calculating and Disclosing our Carbon Footprint

Since 2022, Quantum has publicly reported Scope 1, 2, and 3 financed emissions to provide transparency into the GHG emissions associated with our investment portfolio and demonstrate our commitment to understanding and managing climate-related impacts across our investments. Over time, our emissions reporting strategy has evolved alongside our growth and broader mission to provide reliable energy, including the expansion of our investment strategy to include infrastructure and power.

As a private equity investor, Quantum's financed emissions profile reflects the operational and end-use emissions associated with the portfolio companies and assets in which we invest. Due to the nature of our business, financed emissions fluctuate as assets are acquired, grown, and divested, and as portfolio companies increase production and power generation to meet growing energy demand.

In 2025, Quantum acquired Cogentrix Energy, a leading U.S. power generation company with a portfolio of 11 efficient and flexible natural gas-fired power plants serving major U.S. regional power markets, including Texas, the Mid-Atlantic, and New England. We believe Cogentrix's fleet is uniquely positioned to support grid reliability during periods of high electricity demand while providing the scale and responsiveness needed to support the country's evolving energy needs. The addition of Cogentrix significantly increased Quantum's reported Scope 1 emissions profile, with approximately 74% of Scope 1 emissions attributable to Cogentrix's power generation assets in 2025.

SCOPE 1 EMISSIONS BY VERTICAL – 2025
(Percent)



Because Scope 1 emissions are directly associated with portfolio company operations, we believe they also represent one of the areas where operational improvements and emissions management efforts can have the most meaningful impact. Therefore, Quantum actively works with portfolio companies to identify opportunities to improve operational efficiency, reduce methane emissions, enhance monitoring capabilities, and implement emissions reduction initiatives where practical and economically viable. Examples of these efforts are highlighted on the following pages.

Quantum's Scope 3 emissions are primarily driven by the end-use combustion of oil and natural gas produced across the portfolio. As production volumes and electricity generation increased during the reporting period, associated Scope 3 emissions also increased. While absolute emissions increased year over year, these changes primarily reflect portfolio growth and higher energy output needed to support reliable and affordable energy supply.

Given the dynamic nature of Quantum's investment strategy, year-over-year financed emissions may not always be directly comparable as assets enter and exit the portfolio. In January 2026, Quantum announced the sale of Cogentrix Energy to Vistra in a $4.7 billion transaction. As a result, future reporting periods are expected to reflect a materially different portfolio composition and financed emissions profile.

OUR FINANCED EMISSIONS - 2025
(MT CO_2e)

Scope 1[1] Operational emissions from all sectors reported (upstream, midstream, services, and power)	**13,126,846 MT**
Scope 2[2] Emissions associated with electricity usage including office consumption and electrified operations equipment	**214,620 MT**
Scope 3[3] End-product use for all production and throughput of oil and gas operations	**95,741,036 MT**
Quantum 2025 Total Financed Emissions	**109,082,502 MT**

Data boundaries and scope:
Our emissions analysis includes GHG emissions associated with majority-owned portfolio companies operating in the power and oil and gas sectors as of December 31, 2025. Emissions data has been provided by portfolio companies and has not been independently verified by Quantum or a third party.

(1) Scope 1 emissions include direct operational emissions calculated using 40 CFR Part 98 Subpart W (as available in the EPA's 2024 GHGRP) and calculation worksheets, where applicable. EPA Subpart W reporting deadlines were extended from March 31 to October 30; therefore, certain emissions estimates are preliminary, have not yet been submitted to the EPA, and remain subject to change pending further regulatory updates or revisions to Subpart W requirements. Calculated using a Global Warming Potential (GWP) of 28 for methane; 273 for nitrous oxide. Scope 1 emissions also include vehicle fleet emissions calculated by portfolio companies using the EPA Simplified GHG Emissions Calculator (SGEC). Scope 1 Emissions include emissions from the Services sector, which account for <1% of Scope 1 emissions.
(2) Scope 2 emissions include indirect emissions associated with purchased electricity and are calculated by portfolio companies using the EPA Simplified GHG Emissions Calculator (SGEC).
(3) Scope 3 Category 11 emissions include estimated end-use combustion emissions associated with oil, natural gas, and natural gas liquids (NGL) production volumes reported by portfolio companies.

A Closer Look at GHG Emissions in Oil and Gas Operations

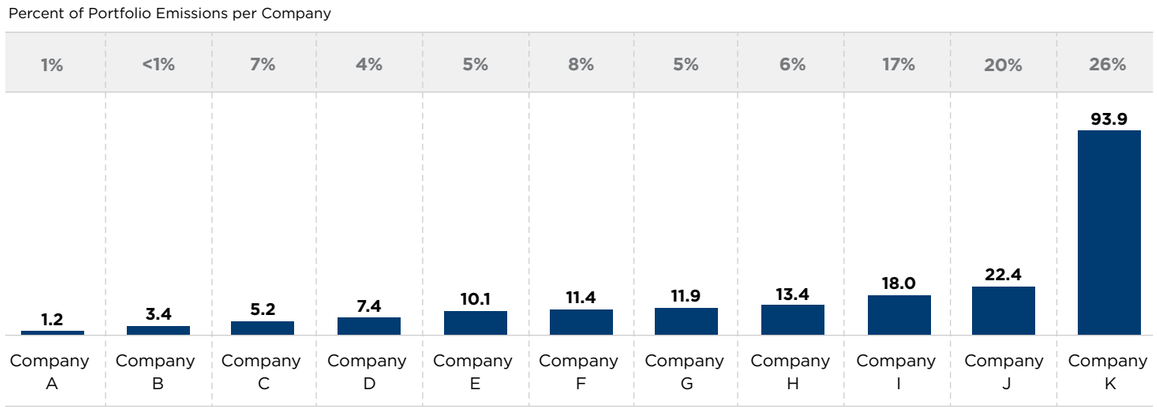
Quantum continues to measure, manage, and reduce GHG emissions across our portfolio, with a heavy focus on oil and gas operational emissions.

Carbon dioxide and methane remain the most material sources of operational emissions across the Quantum oil and gas portfolio. Therefore, they are the primary focus of our tracking and reduction efforts. We also collect data on other greenhouse gases, including nitrous oxide (N_2O), and require portfolio companies to report emissions from company-owned vehicles. While these sources represent a smaller share of total oil and gas emissions and may offer fewer reduction opportunities, we encourage oil and gas companies to evaluate lower-emission alternatives where practical and commercially viable.

Quantum tracks year-over-year GHG metrics to monitor performance, identify emerging risks and opportunities, and support continuous improvement at the asset level. In 2025, total Scope 1 oil and gas portfolio emissions intensity decreased compared to 2024, driven primarily by the formation of new companies and increased production across the portfolio.

Rather than relying solely on portfolio-wide metrics, Quantum emphasizes tracking trends at the individual portfolio company level. We work closely with management teams to understand emissions drivers, strengthen data quality, and identify initiatives that can improve performance over time. We remain focused on helping our oil and gas portfolio companies reduce emissions. We prioritize projects that reduce risks while offering quick payback or the potential to lower regulatory compliance costs in the future.

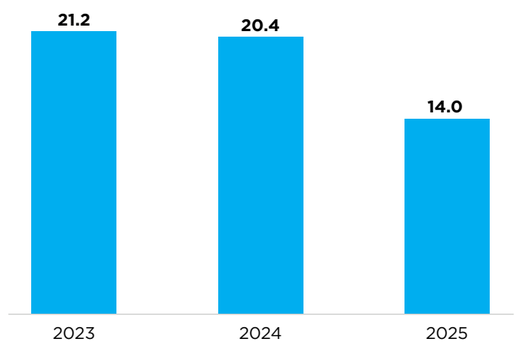
SCOPE 1 GHG INTENSITY BY OIL AND GAS PORTFOLIO COMPANY – 2025
(MT CO_2/Mboe)



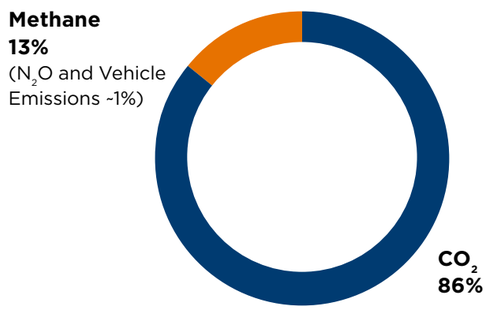
OIL AND GAS PORTFOLIO SCOPE 1 EMISSIONS – 2025[1]

Carbon Dioxide (CO_2) Emissions from combustion in operations and flaring	**2,999,084 MT**
Methane (CH_4) Emissions from venting or leaking natural gas	**461,325 MT**
Nitrous Oxide (N_2O) Another type of emissions resulting from combustion in operations	**2,535 MT**
Vehicle Emissions Emissions from company-owned vehicles	**12,871 MT**
Total Oil and Gas Portfolio Scope 1 Emissions	**3,475,815 MT**

YEAR-OVER-YEAR OIL AND GAS PORTFOLIO SCOPE 1 GHG INTENSITY
Total GHG emissions/total production
(MT CO_2e/Mboe)



OIL AND GAS PORTFOLIO SCOPE 1 OPERATIONAL EMISSIONS – 2025
(Percent)



[1] Scope 1 emissions include direct operational emissions calculated using 2024 EPA Subpart W methodologies and calculation worksheets, where applicable. EPA Subpart W reporting deadlines were extended from March 31 to October 30; therefore, certain emissions estimates are preliminary, have not yet been submitted to the EPA, and remain subject to change pending further regulatory updates or revisions to Subpart W requirements. Calculated using a Global Warming Potential (GWP) of 28 for methane; 273 for nitrous oxide. Scope 1 emissions also include vehicle fleet emissions calculated by portfolio companies using the EPA Simplified GHG Emissions Calculator (SGEC). Emissions have not been verified by Quantum or any third party.

QB Energy Reduces Greenhouse Gas Emissions

Addressing legacy emissions through technology and operational discipline

CASE STUDY

QB Energy	PRIMARY OFFICE **Denver, Colorado**	YEAR OF INVESTMENT **2024**
	QB Energy was formed in 2024 following the acquisition of assets in the Piceance Basin. QB Energy is focused on the acquisition, development, and production of clean-burning, affordable natural gas in the Piceance Basin in Western Colorado.	

In August 2024, QB Energy was formed through the acquisition of Caerus Oil and Gas Assets in the Piceance Basin. These assets represent the largest single asset base in the region and the second-largest natural gas resource in the continental U.S. While the acquisition added significant production capacity, it also introduced emissions associated with legacy wells. QB Energy is well positioned to address these issues. The team brings deep internal environmental expertise, a leading air emissions monitoring program, and a strong commitment to sharing and implementing operational best practices.

Adhering to Stringent State Reporting

As a Colorado-based producer, QB operates under some of the most stringent oil and gas regulations in the country. Colorado is a leader in methane regulation and emissions-limiting technologies, and operators in the state are required to meet higher standards for emissions performance, data quality, and transparency. A central component of this framework is Colorado's Regulation 7 air quality rule, which includes enhanced Leak Detection and Repair (LDAR) requirements, phased deadlines for non-emitting pneumatics, and state-mandated upstream GHG emissions intensity targets.

Addressing Pneumatic Device Emissions

Natural gas-powered pneumatic controllers, which serve as pressure control devices, intermittently emit a small amount of natural gas when actuating. These devices are commonly found in legacy assets or in areas with limited electricity access, where facilities cannot be powered by the grid. These controllers are a significant driver of methane emissions for many U.S. operators, with a benchmarking report showing that pneumatic controllers accounted for more than 67% of total reported methane emissions countrywide in 2022.[1] For QB, methane emissions from pneumatic controllers represented 57% of total emissions in 2024.

The State of Colorado requires all pneumatic controllers to be removed by May of 2029, with interim reduction targets for each year. QB has faced challenges, including limited grid access. In response, the team has implemented creative solutions such as air compression, solar skids, and nitrogen-powered facilities to phase out high-emitting pneumatics and exceed the state's interim targets.

29% reduction in GHG emissions between 2024 and 2025[2]

0% flaring at well pad facilities

4,000 pneumatic devices replaced in 2025

An Advanced Leak Detection Program

QB operates a multi-layered methane detection program that combines routine LDAR surveys, Optical Gas Imaging (OGI) inspections, aerial flyovers, and advanced monitoring technologies to improve detection speed and emissions visibility. Together, these tools help identify both persistent and intermittent emission sources that can be missed by periodic inspections alone.

At higher-risk facilities, QB deploys continuous monitoring systems that provide near real-time emissions data and automated alerts when methane concentrations exceed defined thresholds. These systems have helped QB identify equipment malfunctions, pressure relief events, and closed vent system failures that were not observable during scheduled inspections. In multiple cases, monitoring data directly triggered repairs and operational changes that resulted in sustained methane reductions and increased gas capture.

Aerial flyover surveys complement site-level inspections by providing facility-level emissions data across the asset base and helping prioritize follow-up inspections. Data from OGI inspections, LDAR surveys, continuous monitors, and flyovers are consolidated into internal dashboards. The team uses this information to identify recurring failure modes, evaluate repair effectiveness, and refine maintenance practices. This integrated approach allows QB to move from reactive compliance to predictive, performance-based methane management.

Any estimates, expectations, or projections are provided for informational purposes only and are not necessarily indicative, or a guarantee, of future results. Numbers are estimates provided directly by portfolio companies and have not been verified by Quantum or any third party.

(1) Ceres, Clean Air Task Force (CATF), and ERM. (2024). Benchmarking Methane and Other Greenhouse Gas Emissions of Oil and Natural Gas Production in the United States.

(2) GHG emissions were calculated by QB using 2024 Subpart W methodology and have not been verified by Quantum or a third party.

SPOTLIGHT

OGMP 2.0 Initiative

In 2025, QB joined the UN's Oil and Gas Methane Partnership (OGMP) 2.0. This globally recognized, voluntary framework establishes a standard for methane emissions measurement, reporting, and mitigation across the oil and gas sector. OGMP 2.0 focuses on asset-level, source-specific methane quantification and transparent, annual disclosures. Participation reflects alignment with leading industry practices and evolving regulatory and investor expectations related to methane emissions management.

OGMP 2.0 members commit to a structured, tiered reporting framework that emphasizes continuous improvement in emissions data quality, increased use of direct measurement, and independently reviewed disclosures. Participants are expected to set methane management objectives and implement monitoring and mitigation programs that demonstrate measurable progress. QB Energy's participation in OGMP 2.0 underscores a disciplined approach to emissions oversight, enhanced data integrity, and proactive positioning for long-term regulatory and capital market requirements.

SPOTLIGHT

The Environmental Partnership

QB Energy's Jerry Dismukes, Air Compliance Manager, is serving as a Chairperson for the Measurement, Monitoring, & Reporting Network of the Environmental Partnership. Working alongside 28 other air quality experts, Jerry brings extensive experience in emissions management and regulatory compliance, helping advance industry best practices and navigate an evolving regulatory landscape.

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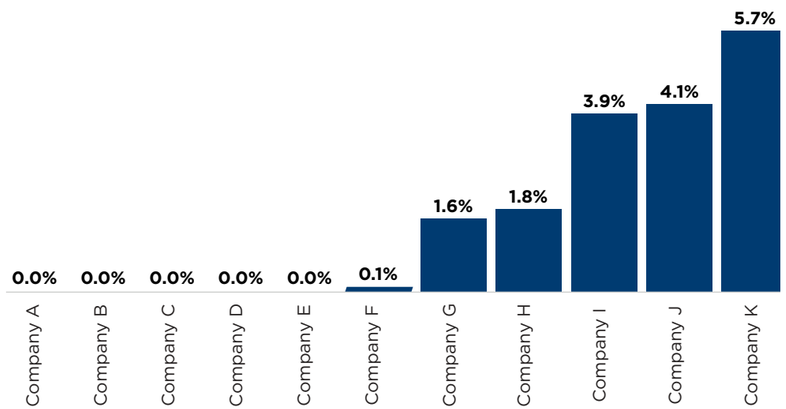
Flaring in Oil and Gas Operations

Quantum is committed to minimizing routine flaring across our oil and gas portfolio as part of our broader strategy to drive operational efficiency and maximize resource value. Flaring – the controlled burning of excess natural gas – often results from takeaway constraints, infrastructure limitations, or operational safety requirements.

These challenges persist in certain onshore basins where Quantum operates, as well as within our offshore oil and gas portfolio. By partnering with management teams to address these constraints, we aim to increase gas capture rates, reduce waste, and unlock incremental revenue opportunities, while also lowering emissions intensity.

Quantum focuses on flaring performance at the individual oil and gas portfolio company level. We work with operators – particularly oil-focused companies facing takeaway constraints – to identify and prioritize projects with the greatest potential to reduce flaring. Key areas of focus include the Permian, Williston, and Powder River basins, as well as offshore operations.

% GAS FLARED BY OIL AND GAS PORTFOLIO COMPANY – 2025[1]
(Percent)



SPOTLIGHT

Trident Energy Improves Flaring Offshore

Across its offshore portfolio, Trident Energy has made targeted investments to reduce flaring in complex operating environments where infrastructure constraints limit traditional gas utilization options. In Equatorial Guinea, Trident faces a significant challenge: there are currently no gas networks available to connect their offshore asset to onshore markets, resulting in excess gas being flared rather than used for power generation. To address this, Trident has approved a capital program that includes new gas compression facilities and its Gas Injection Network Integration (GINI) project, which connects wells and processing systems so excess gas can be reinjected into the reservoir. Together, these initiatives enable Trident to reinject surplus gas, reduce routine flaring, and improve overall asset efficiency at the Congo field.

In Brazil and the Republic of Congo, Trident continues to focus on flare reduction opportunities through its Flare Hunting Program, which is designed to proactively identify and address operational drivers of flaring. The program includes systematic inspection, repair, and replacement of equipment and valves that can contribute to emergency shutdowns, depressurizations, and elevated flare volumes. It also utilizes LiDAR camera inspections to identify and rectify sources of emissions from pipework or connections.

28%

Reduction of routine flaring

across Trident's assets from 2022 to 2024

Please see disclosures for important information regarding ESG considerations in our investment practices. There can be no assurance that any historical trends will continue.

(1) Quantum's total flaring intensity is estimated using aggregated data provided by portfolio companies. Portfolio company data has not been verified by Quantum or any third party.

FireBird Energy Minimizes Flaring in the Permian Basin

Turning associated gas into an operational advantage

CASE STUDY

PRIMARY OFFICE	YEAR OF INVESTMENT
Fort Worth, Texas	**2023**

FireBird Energy LLC is a Fort Worth, Texas-based upstream oil and gas company focused on the acquisition and responsible development of assets in the Midland Basin. With a strong long-term commitment from its ownership and an innovative and experienced management team in both its Fort Worth and Midland offices, FireBird is well positioned to pursue strategic acquisition opportunities and develop its properties in a fiscally and socially responsible manner.

FireBird Energy is a Permian Basin–focused operator with an emphasis on disciplined development, operational efficiency, and responsible resource management. Like many operators in the region, FireBird operates amid rapid production growth, constrained midstream capacity, and limited utility power availability. These conditions make flaring a persistent and highly scrutinized challenge across the basin.

FireBird's approach to flaring reduction reflects continuous operational improvements rather than a one-time fix. Following its November 2023 acquisition of Summit Petroleum assets, FireBird assumed control of 16 wells that were coming online with gas and electrical infrastructure undersized for expected production volumes. Rather than accepting elevated flaring as a short-term outcome, FireBird implemented infrastructure upgrades to redirect gas, utilize conditioned field gas for operations, and reduce emissions while maintaining production reliability.

A central component of this approach was on-lease power generation. Because local utility infrastructure could not supply sufficient electricity, FireBird generated 4–4.5 megawatts of power using associated natural gas. This allowed drilling and production activities to continue without interruption while reducing reliance on diesel and minimizing flaring.

These initial efforts established a foundation for longer-term progress. One early application of this approach occurred at the Aletha site, where FireBird implemented on-lease gas utilization and temporary power solutions to reduce flaring while awaiting additional midstream connectivity. In 2024, once the primary midstream operator completed a second gas connection along a separate route, FireBird was able to power down the Aletha site, reflecting improved third-party infrastructure reliability. Learnings from Aletha, combined with continued constraints in utility-sourced electricity, informed a larger-scale application of this approach at the Lois site.

The Lois site came online in October 2024 and represents a scaled implementation of gas utilization and on-lease power generation. In 2025, approximately 3 BCF of gas was redirected to alternate gatherers or utilized for operations rather than flared. In addition, approximately 1.4 million gallons of natural gas liquids were recovered from gas that would have otherwise been consumed or flared. On-lease energy utilization displaced an estimated 18,000 gallons of diesel and eliminated approximately 265 truck deliveries. As a result, FireBird reduced transportation-related emissions and road traffic.

In parallel, third-party infrastructure continued to improve. Over the past year, the primary gas gatherer looped lines and strengthened system reliability, contributing to additional reductions in flaring. FireBird's flaring emissions declined by 23% in the second quarter of 2025 and continued to decrease further in the third quarter. The company expects to continue utilizing lease gas as capital efficiency and emissions performance improve.

In a basin under increasing regulatory and public scrutiny, we believe FireBird's experience demonstrates that sustained flaring reduction is achieved through adaptability and ongoing operational focus. By continuously refining its approach as infrastructure and operating conditions evolve, FireBird seeks to reinforce its commitment to responsible development and emissions management in the Permian Basin.

3 Bcf
gas repurposed or redirected from flare in 2025

1.4 million
gallons of NGL salvaged

265
loads of CNG truck deliveries kept off the road

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Methane Emissions in Oil and Gas Operations

Managing methane emissions remains a critical priority for Quantum, as methane is a highly potent greenhouse gas with a significantly greater short-term warming impact than carbon dioxide. We believe that proactive methane management strengthens environmental performance and supports financial outcomes by reducing regulatory exposure, improving operational efficiency, and protecting asset value.

Each year, Quantum collects methane data from oil and gas portfolio companies and conducts detailed analyses to identify reduction opportunities. We benchmark performance against a methane intensity level of 0.2%, a widely referenced industry threshold recommended by nongovernmental organizations and aligned with the former U.S. Waste Emissions Charge (WEC). In 2025, methane accounted for 13% of operational emissions across our oil and gas portfolio, and our portfolio-wide methane intensity of 0.08% was below our 0.2% benchmark.

As with other portfolio-wide metrics, methane intensity can fluctuate year over year as companies enter or exit the portfolio, production levels change, or operating conditions evolve. Rather than relying solely on aggregated metrics, Quantum focuses on strengthening methane management practices at the asset and company level, where targeted actions can improve efficiency, reduce costs, and protect financial performance. Our approach to methane management emphasizes three core areas: proactive planning in new developments, retrofits and upgrades to existing infrastructure, and robust LDAR programs.

Proactive Planning

When developing new assets, oil and gas portfolio companies consider facility designs that minimize methane emissions from the outset. This includes electrifying operations where feasible, securing sufficient gas takeaway capacity to support future development, and deploying technologies that reduce venting.

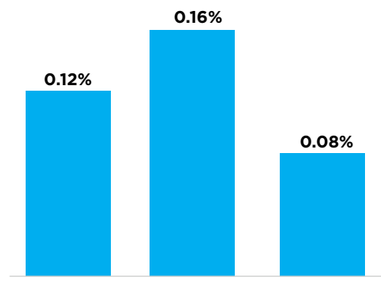
Retrofits and Upgrades

Through acquisitions, oil and gas portfolio companies may inherit legacy equipment that requires upgrades to reduce methane emissions. Quantum companies have a track record of improving infrastructure and onsite equipment – such as expanding pipeline capacity and replacing gas-driven pneumatics with lower-emission alternatives – to achieve meaningful methane reductions.

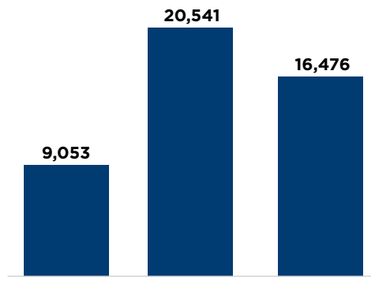
LDAR

Keeping natural gas in the pipeline is both an environmental and economic priority. Quantum oil and gas portfolio companies deploy multi-layered LDAR programs using a combination of OGI cameras, continuous monitoring systems, and aerial surveys. These complementary tools enable faster detection, improved maintenance planning, and greater operational reliability.

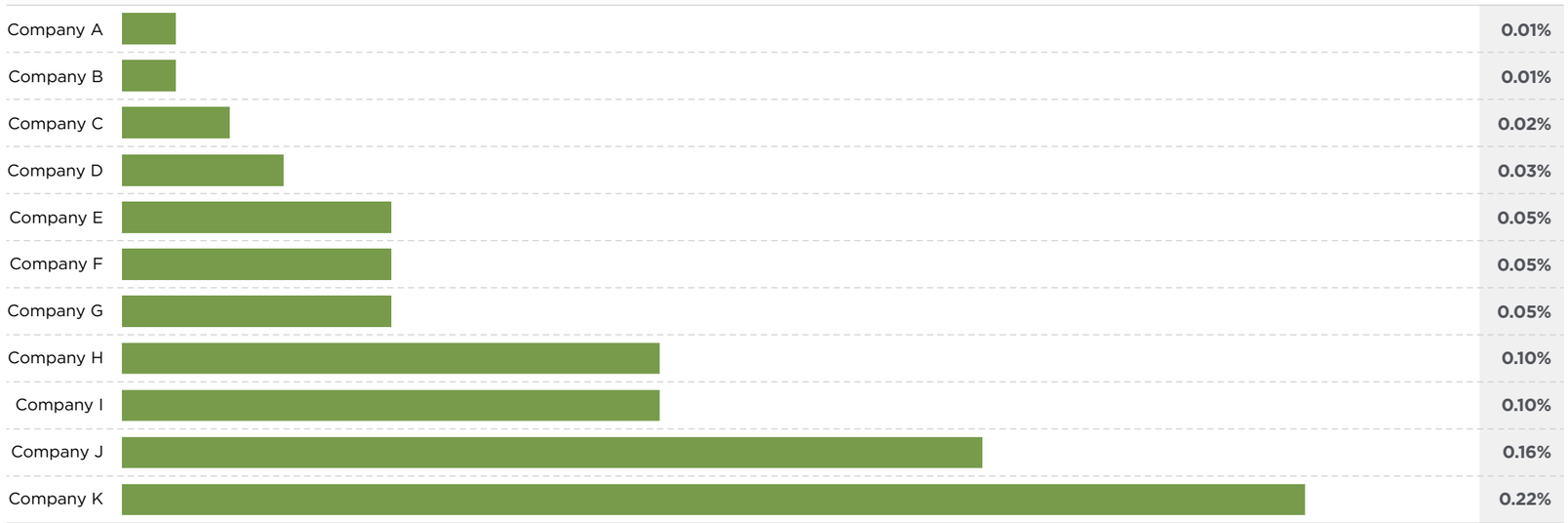
YEAR-OVER-YEAR OIL AND GAS PORTFOLIO NGSI METHANE INTENSITY[1]
Methane emissions from natural gas/methane content of natural gas throughput
(Percent)



YEAR-OVER-YEAR OIL AND GAS PORTFOLIO METHANE EMISSIONS[2]
(MT CH_4)



METHANE INTENSITY BY OIL AND GAS PORTFOLIO COMPANY – 2025[3]
(Percent)



Please see disclosures for important information regarding ESG considerations in our investment practices. There can be no assurance that any historical trends will continue. Quantum's total portfolio methane intensity is estimated using aggregated data provided by portfolio companies. Portfolio company data has not been verified by Quantum or any third party.

(1) Quantum calculates methane intensity in accordance with the Natural Gas Sustainability Initiative (NGSI) protocol. Data may exclude portfolio companies that did not report data.
(2) While most portfolio companies report methane emissions using EPA Subpart W methodology (40 CFR Part 98, Subpart W), some companies may use alternative calculation methods. Data may exclude portfolio companies that did not report data.
(3) Quantum's total portfolio methane intensity is estimated using aggregated data provided by portfolio companies. Portfolio company data has not been verified by Quantum or any third party. Data may exclude portfolio companies that did not report data. Due to EPA's extension of the reporting deadline and ongoing reconsideration of Subpart W reporting requirements (90 FR 44591, Sept. 16, 2025), 2025 emissions data has not yet been submitted to EPA and remains subject to change.

KODA's Continued Dedication to Methane Reduction

Managing growth while strengthening operational performance

CASE STUDY

	PRIMARY OFFICE	YEAR OF INVESTMENT
KODA	Denver, Colorado	2018
	KODA Resources, LLC is focused on the acquisition and development of oil and gas properties in the Rocky Mountain Region. It is actively operating in the Williston and Uinta Basins.	

KODA Resources, an operator in the Uinta and Williston basins, has grown through strategic acquisitions across the U.S. Rockies region. During this time of growth, as new assets – including more challenging legacy assets – entered the portfolio, KODA steadily improved methane intensity year over year through a disciplined approach, completing high-value emissions reduction projects that also increased operational efficiency.

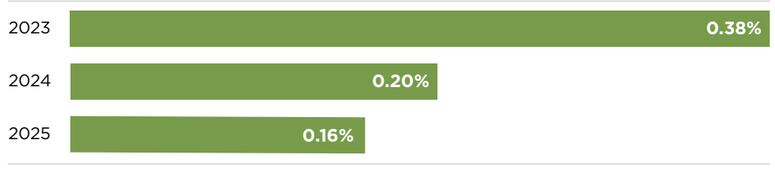
Considering Potential Regulations

Amid a rapidly changing regulatory landscape, KODA is focused on projects that reduce emissions from major sources, safeguard regulatory compliance, and ease the burden of reporting requirements. KODA's new facilities are lower emitters that are powered by the grid with limited potential emissions sources. However, the company continues to replace older equipment that could later be regulated under the U.S. Environmental Protection Agency's proposed OOOOc rule. While regulatory uncertainty persists, KODA aims to remain flexible and prepared to comply as rules come into effect. The benefit is twofold: older equipment is being replaced with systems that are less prone to leaks, keeping valuable natural gas in pipelines, while positioning the company to meet future regulatory requirements.

Consistent Reductions Over Time

Over the past several years, KODA has developed ESG expertise that enables continued reductions in methane intensity even as new inventory is added. The company seeks to act quickly to address methane emissions from newly-acquired assets, including deploying Crusoe/NYDIG units to capture gas in the Williston basin. Following its 2024 acquisition of assets in Utah's Uinta Basin, KODA identified methane emissions as a key inherited ESG challenge and rapidly prioritized targeted mitigation efforts. Building on due diligence findings, the company focused on high-impact pneumatic upgrades and infrastructure improvements to materially reduce emissions while strengthening operational and regulatory performance.

YEAR-OVER-YEAR PORTFOLIO NGSI METHANE INTENSITY
Methane emissions from natural gas/methane content of natural gas throughput (Percent)



Indicates methane/ESG goal

- **2018** — Quantum partners with KODA Resources leadership team
- **2020** — KODA merges with Middle Fork Energy Partners to increase scale, combine complementary strengths, and apply KODA's technical and operating capabilities to improve Middle Fork's legacy assets
- **2021** — KODA deploys first Crusoe/NYDIG units to capture gas and reduce flaring in the Williston Basin
- **2022** — KODA builds its first new pad connected to the grid, with minimal methane emissions sources
- **2023** — KODA receives the Utah Petroleum Association (UPA) environmental leadership award for its efforts to reduce methane during flowback
- **2023** — KODA engages Tegre Corporation for overhaul of pneumatic device inventory
- **2023** — KODA implements initial centralized air compression project for 182 legacy wells
- **2024** — KODA acquires Caerus Uinta Basin assets as part of a $1.8B transaction, alongside QB Energy's acquisition of Piceance Basin assets
- **2025** — KODA targets methane emissions inherited from Caerus, with a Phase 2 air compression program for 100 facilities

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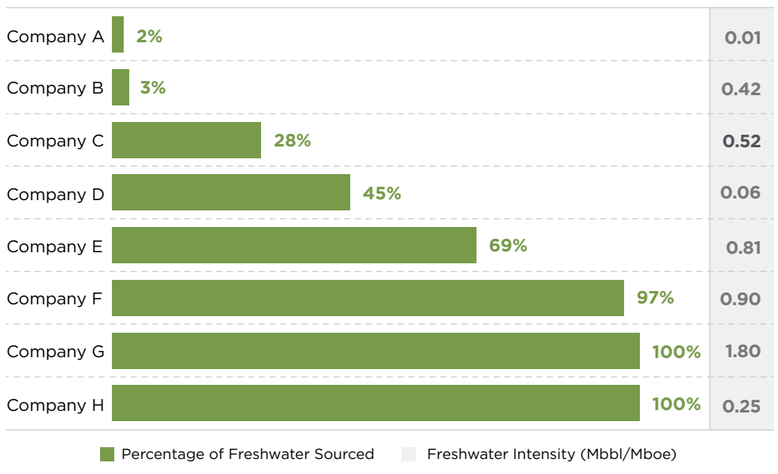
Water

Reducing freshwater consumption is a core part of Quantum's approach to managing operational costs, mitigating water-related risks, and strengthening portfolio resilience. Water plays an essential role in many portfolio company operations, especially in activities such as hydraulic fracturing and steam flood operations. We encourage portfolio companies to use alternate water sources where possible and to expand recycling efforts. We also evaluate regional water scarcity risks as part of investment oversight. Together, these actions help companies operate more efficiently while maintaining a strong license to operate.

In 2025, approximately 68% of total water sourced by Quantum portfolio companies came from non-freshwater sources, including recycled, brackish, or produced water. This compares to 72% in 2024 and 79% in 2023. The year-over-year decline primarily reflects changes in portfolio composition, operational activity levels, and water sourcing requirements across certain assets.

TOTAL FRESHWATER CONSUMPTION – 2025[1]
(Percent)



[1] Quantum's total non-freshwater usage is calculated using aggregated data provided by portfolio companies. Portfolio company data has not been verified by Quantum or any third party.

Identifying Water-Stressed Assets

To better understand our water footprint and manage water-related risk, Quantum maps regional water scarcity using the World Resources Institute (WRI) Aqueduct tool. This analysis helps identify portfolio company operations located in areas of elevated water stress and informs discussions around water sourcing, recycling, and operational planning. We intend to perform this assessment annually to keep our analysis current.

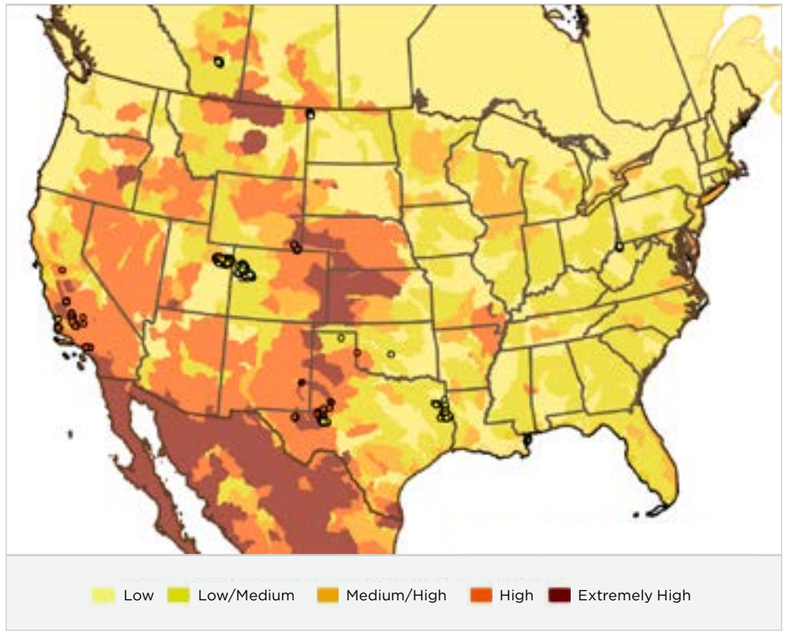
As shown in the map, a limited number of Quantum portfolio companies operate in areas of high or extremely high water stress. These companies, along with others across the portfolio, implement water management initiatives that support both environmental stewardship and operational performance, including reducing freshwater withdrawals, increasing water recycling and reuse, and optimizing water transportation and logistics.

Portfolio Company Water Use

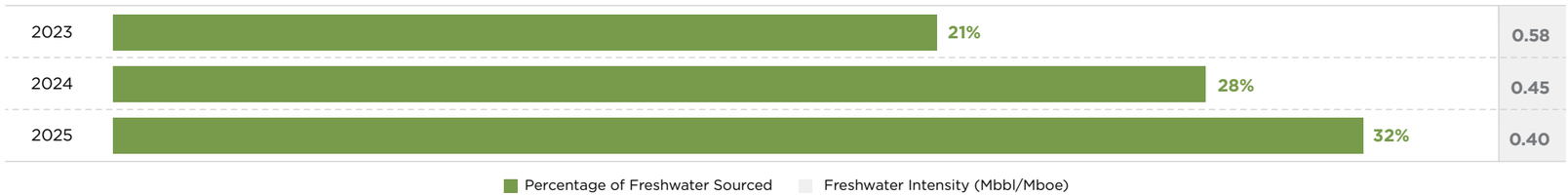
Water use across the portfolio is primarily driven by hydraulic fracturing activities at companies that are expanding drilling and completions programs, as well as steam flood operations in California. In hydraulic fracturing, large volumes of water – typically ranging from 1.5 to 16 million gallons per well – are injected at high pressure to stimulate production in low-permeability formations. These large volumes also create opportunities to implement water recycling programs, which can deliver significant cost savings by reducing both freshwater procurement and wastewater disposal requirements.

By continuing to emphasize alternative water sourcing, recycling, and data-driven risk assessments, Quantum seeks to reduce freshwater consumption while supporting efficient, resilient operations across the portfolio.

WATER SCARCITY ASSESSMENT



YEAR-OVER-YEAR FRESHWATER INTENSITY
(Mbbl/Mboe)



QB's Comprehensive Water Program

Managing water responsibly in a water-constrained region

CASE STUDY

QB Energy is a Quantum portfolio company that was formed following the acquisition of legacy natural gas assets in the Piceance Basin of Western Colorado. The basin is characterized by limited surface water availability, complex geology, and heightened regulatory oversight. Because of these challenges, and as droughts and water shortages continue to plague the West, effective water management is a critical operational and environmental priority. QB Energy's approach to water quality protection, regulatory compliance, and operational efficiency reflects a disciplined water management strategy that supports environmental risk mitigation while enabling reliable production.

Operating Within a Stringent Regulatory Environment

QB Energy operates under Colorado's comprehensive oil and gas water management framework, which includes permitting, monitoring, and reporting requirements for produced water handling, storage, reuse, and disposal. State regulations emphasize groundwater protection, spill prevention, and transparency. They require operators to demonstrate robust controls across the full water lifecycle.

QB's water management program is designed to meet or exceed applicable state and local requirements. The company focuses on preventing surface and subsurface impacts and maintaining water quality integrity.

Centralized Water Treatment at the Divide Road Facility

QB's water management program is anchored by the Divide Road Water Treatment Facility, a centralized asset designed to manage produced water volumes at scale across the basin. The primary water management system is further supported by two additional centralized exploration and production facilities. Produced water is transported – predominantly via pipeline – from well pads to the nearest treatment facility, where it undergoes processing to remove hydrocarbons, suspended solids, and other constituents to specifications suitable for reuse or compliant disposal.

The facility enables QB to consolidate water handling, improve consistency in water quality control, and reduce reliance on decentralized storage and trucking. In 2025, the facility treated approximately 16.4 million barrels of produced water, representing the majority of QB's produced water volumes.

Continuous operations and adequate planning assist QB in maximizing the reuse percentage of field-produced water and minimizing fresh water entering the system.

~18.7 million barrels of produced water treated in the QB Parachute Water System

96% of produced water reused, reducing freshwater demand

100% of produced water managed through permitted infrastructure

Regulatory Oversight and Reporting

As a Colorado-based operator, QB reports water-related activities to multiple state agencies, including:

- **Colorado Energy and Carbon Management Commission (ECMC):** ECMC provides oversight of produced water handling, spill prevention, facility permitting, and operational compliance under Rules Series 300, 400, and 900.
- **Colorado Department of Public Health and Environment (CDPHE):** CDPHE provides water quality protection and waste management oversight through the Water Quality Control Division.
- **Colorado Division of Water Resources (DWR):** DWR oversees freshwater sourcing and water rights, where applicable.

Water volumes, reuse rates, and disposal pathways are reported through state-mandated systems and facility-specific permit conditions. Any reportable releases are subject to immediate notification, investigation, and corrective action in coordination with applicable regulators.

QB's Divide Road Treatment Facility

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Safety and Human Capital Management

Our goal is to strengthen human capital management practices across the portfolio by building workforces that are safe, engaged, and productive. We believe effective human capital management supports operational efficiency, strengthens competitiveness, and underpins long-term organizational performance.

Safety

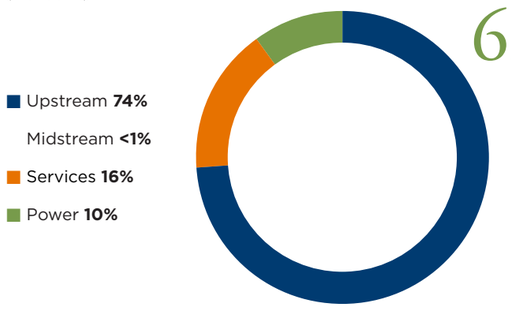
Quantum works closely with portfolio companies to promote a culture that prioritizes the safety and well-being of employees and contractors. By emphasizing safety, we seek to reduce the risks and costs associated with workplace incidents, including regulatory exposure, higher insurance premiums, and productivity losses. We believe a strong safety culture also supports workforce morale and more reliable operations.

In 2025, Quantum portfolio companies collectively worked over 6 million hours, achieving a Total Recordable Incident Rate (TRIR) of 0.64. This data reflects majority-owned portfolio companies where Quantum maintains operational control, with a particular focus on upstream and oilfield services businesses, where operational risks are typically higher.

Asset Integrity and Process Safety

Within our oil and gas portfolio, we emphasize asset integrity and process safety as core components of operational risk management. We encourage portfolio companies to apply a lifecycle approach to asset management – spanning design, inspection, maintenance, and replacement – while balancing safety and cost considerations. Proactive asset integrity practices can help protect personnel, reduce the risk of environmental incidents, and support reliable, uninterrupted operations.

HOURS WORKED – 2025
(Percent)

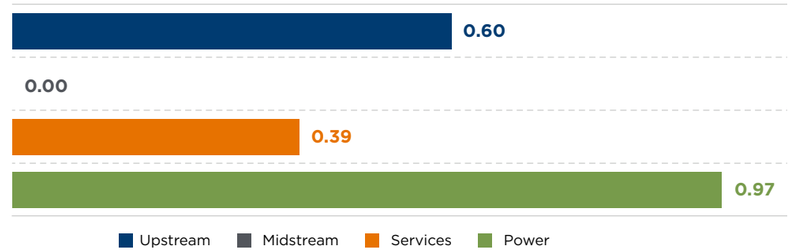


6 million+ hours

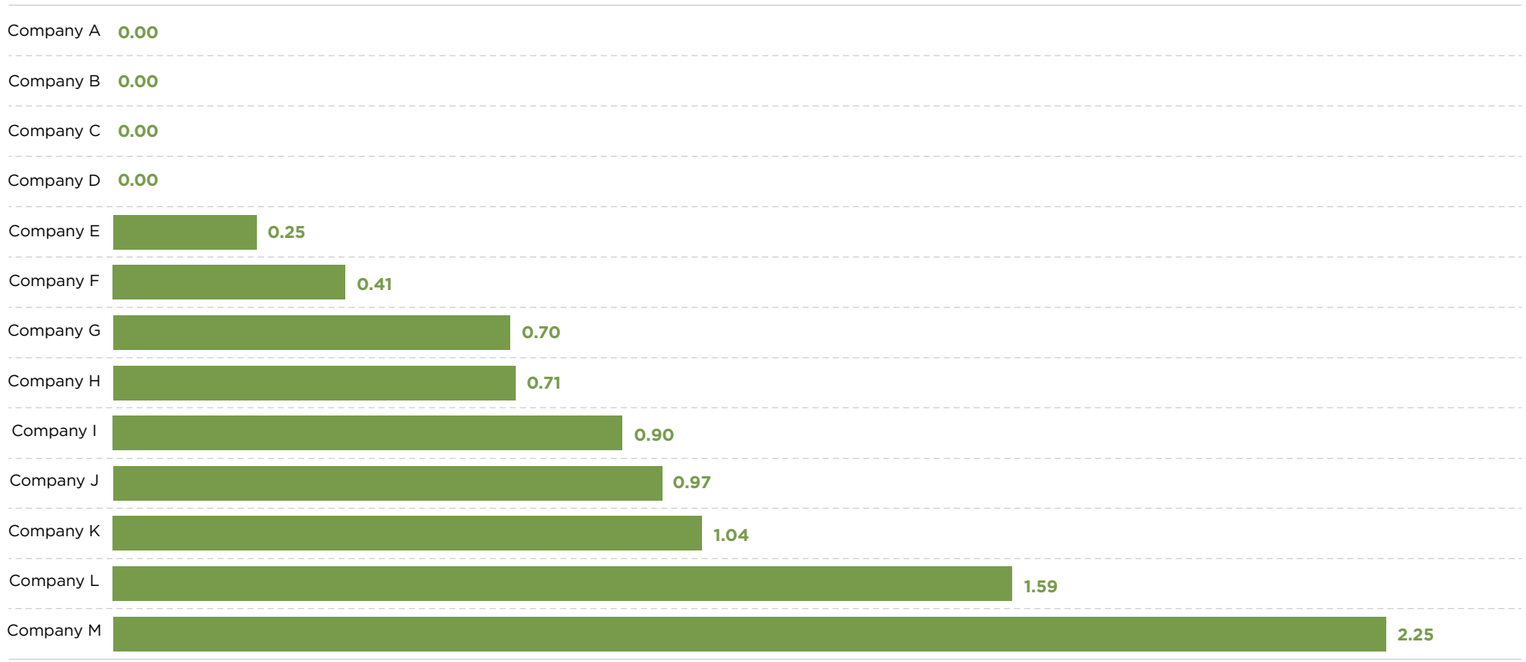
Employees of Quantum portfolio companies collectively worked over 6 million hours in 2025

YEAR-OVER-YEAR EMPLOYEE TOTAL RECORDABLE INCIDENT RATE (TRIR) - 2025

EMPLOYEE TRIR BY INDUSTRY VERTICAL – 2025



EMPLOYEE TRIR BY PORTFOLIO COMPANY – 2025

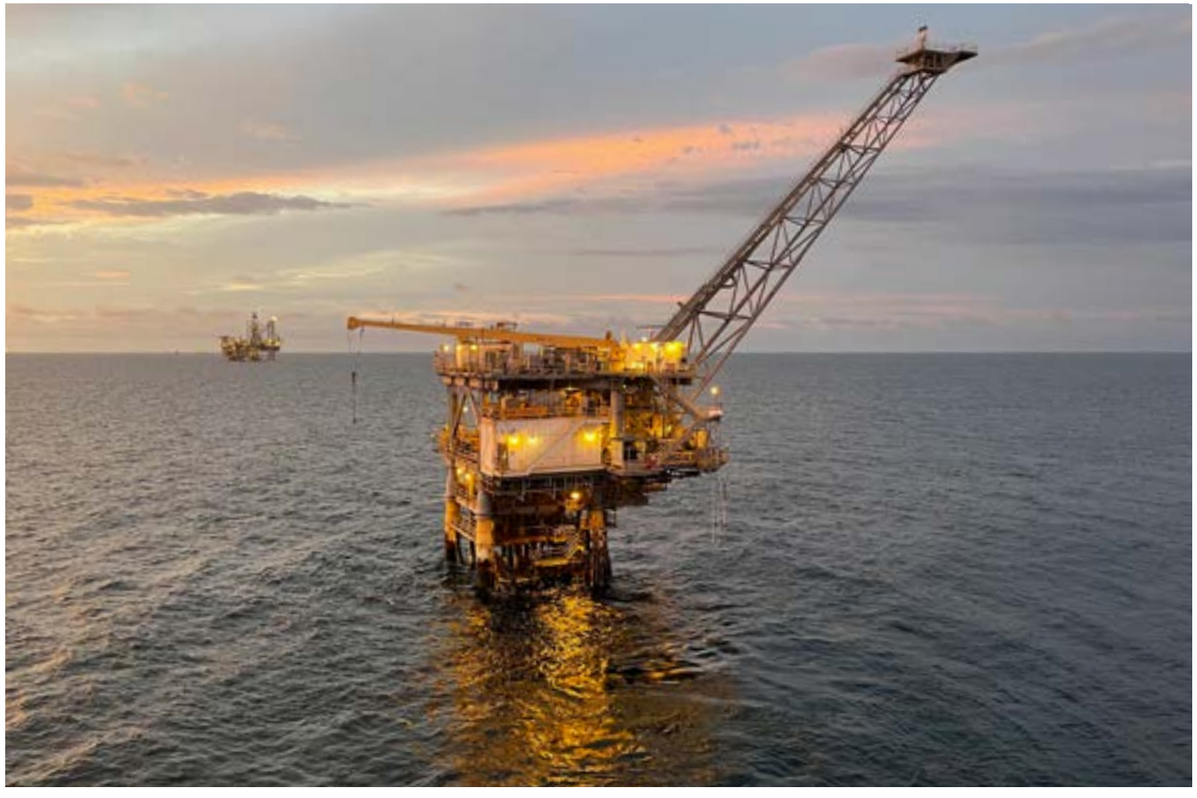


Trident Energy's Robust Safety Program

Building readiness across complex operating environments

CASE STUDY

	PRIMARY OFFICE	YEAR OF INVESTMENT
TRIDENT ENERGY	London, England	2022
	Trident Energy is an international upstream company founded in 2016, focused on building a geographically diversified portfolio of operated, mid-life oil and natural gas assets.	



As an international offshore operator, Trident strives to maintain a rigorous safety program across its operations in Brazil, Republic of Congo, and Equatorial Guinea. The company maintains a safety-first culture, with structured programs that focus on training employees to understand role requirements, follow established safety processes, and proactively address safety concerns. One such initiative launched in 2025 was Trident's Safety Sundays. These dedicated sessions bring teams across Trident's assets together to pause, reflect, and reinforce safe work practices. The initiative strengthens hazard awareness, encourages open dialogue, and promotes personal accountability at every level of the organization. In 2025, Trident also worked with employees and contractors to enhance minimum safety standards, implement highly interactive gamified safety training for personnel working on Trident-operated assets, and reinforce the International Association of Oil and Gas Producers' (IOGP) Life-Saving Rules. Complementing these efforts, Trident maintains an incident learning program, a robust Process Safety Management (PSM) framework, and a strong focus on crisis and emergency management.

Trident's PSM program is designed to prevent incidents involving the release of hazardous materials. It requires regular inspections, integrity reviews, and timely interventions to manage operational risks and extend asset life. Maintenance is viewed not as routine activity, but as a critical safeguard against failures that could escalate into major incidents.

Major incidents are managed by the Crisis Management Team (CMT), which operates out of the company's corporate office in London. In recent years, the CMT has been focused on streamlining its systems to improve decision-making efficiency and strengthen emergency preparedness. It aims to ensure Trident is prepared and equipped to respond to emergencies and crises and mitigate their impact on people, the environment, and Trident's assets and reputation.

Throughout the year, emergency response drills are conducted across all subsidiaries. In 2025, Trident completed work to integrate subsea response capability across Equatorial Guinea and in Brazil. Additionally, in Brazil, a full Oil Spill Response exercise, which included full deployment of specialist equipment and mobilization of beach cleanup teams, was successfully executed. The company is also a member of Oil Spill Response Limited (OSRL), the West Africa Surveillance Platform (WASP), and the Subsea Well Intervention Service (SWIS).

"Nothing is more important than safety – planning is crucial to ensuring that everyone gets home safe at the end of the day."

Paul Coward,
Head of Safety and Sustainability, Trident Energy

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Appendices

Inside this section:

Appendix A: TCFD

The Task Force on Climate-related Financial Disclosures (TCFD) is an initiative established by the Financial Stability Board (FSB) in 2015. The primary goal of the TCFD is to improve and increase the reporting of climate-related financial information, helping investors, lenders, insurers, and other stakeholders assess and manage risks and opportunities related to climate change. This section summarizes how Quantum Capital Group's climate reporting aligns with the TCFD recommendations.

Governance

The Executive Team oversees the implementation of Quantum's risk management processes and ESG Policy, which includes oversight of climate-related risks. Quantum's Investment Committee is responsible for making final investment decisions. The IC meets as needed to evaluate potential investments and considers climate-related issues, risks, and opportunities, when applicable, as part of its decision-making process. Quantum also maintains an ESG Committee, comprised of senior leaders and led by Quantum's Head of ESG, which provides oversight of ESG strategy and program management.

Strategy

Quantum's strategy for identifying and managing material climate-related risks and opportunities is two-fold: (i) firmwide infrastructure and processes that support the analysis of climate-related risks, and (ii) distributed responsibility among investment professionals to review and manage investment risks, including climate-related risks, across portfolio companies.

Quantum seeks to monitor existing investments and perform due diligence on potential new investments, where applicable and reasonably feasible, using a customized set of ESG factors to evaluate a range of ESG considerations, including (but not limited to) climate-related risks. When material risks and opportunities associated with a potential investment are discovered during due diligence, they are presented to the Quantum Investment Committee. This diligence analysis often includes a review of historical ESG performance and considers future ESG issues and opportunities that Quantum investment professionals analyze along with other financial considerations.

Risk Management

Transitional Risks and Opportunities

In 2025, Quantum completed a climate risk assessment with portfolio company Risilience to evaluate the potential financial impacts of climate-related transition risks and opportunities across representative portfolio companies. The assessment utilized NGFS Phase V scenarios and evaluated potential impacts through 2050 under a range of future policy, market, and economic pathways.

The assessment considered several categories of transition risk, including policy, market demand, litigation, technology, and reputation.

- **Policy Risk**
  Policy risk reflects potential financial impacts associated with future carbon pricing mechanisms, including carbon taxes and emissions trading systems. The assessment found that policy risk represents the largest modeled transition risk across the portfolio under more ambitious decarbonization pathways, particularly for emissions-intensive assets and businesses expected to experience significant growth. While widespread carbon pricing is not anticipated in the near term, the assessment highlights the sensitivity of certain assets to future regulatory developments and policy convergence.
- **Market Demand Risk**
  Market demand risk considers the potential impacts of changing customer demand resulting from evolving energy markets, technology adoption, and macroeconomic trends. Given the portfolio's concentration in North American energy infrastructure and production, future demand trajectories for oil, natural gas, power generation, and related energy services remain important considerations in evaluating long-term asset value and investment returns. The assessment found that demand-related impacts were generally consistent across the portfolio, although the magnitude varied based on company size and revenue exposure.
- **Litigation Risk**
  Litigation risk evaluates the potential financial impacts associated with climate-related legal actions, including environmental claims, public nuisance allegations, and directors' and officers' liabilities. The assessment identified limited exposure across the portfolio during the assessment period, reflecting the portfolio's market position and predominantly business-to-business operating models.
- **Technology and Reputation Risks**
  Quantum also evaluates longer-term risks associated with technological change, evolving stakeholder expectations, workforce attraction and retention, and broader market perceptions. Technology risks may arise from changes in energy systems, evolving customer preferences, and the potential for asset impairment over time, while reputational risks may affect talent attraction, stakeholder relationships, and long-term valuation. Although these risks were not identified as material drivers over the modeled assessment period, they remain important considerations in investment underwriting, portfolio management, and exit planning.

Physical Risks

In addition to transition risks, Quantum evaluated the potential impacts of physical climate risks across representative portfolio assets. The assessment analyzed exposure to acute climate hazards, including extreme heat, freezing conditions, flooding, and severe wind events under multiple climate scenarios.

The assessment found that physical climate risks are highly dependent on asset location, operating environment, and hazard type. Overall portfolio exposure was assessed as limited over the modeled period, although individual assets demonstrated varying levels of sensitivity to specific climate hazards.

Notably, several assets located in northern operating regions benefited from projected reductions in severe freeze events, which historically have contributed to operational disruptions and production downtime. As a result, the assessment identified potential operational benefits for certain assets under multiple climate pathways. Other assets exhibited limited sensitivity to projected climate-related changes over the assessment horizon.

Quantum uses the results of these assessments to enhance investment diligence, inform portfolio company engagement, strengthen risk management practices, and support long-term value creation across the portfolio.

Metrics and Targets

Quantum's metrics and targets are outlined on pages 51 and 55-61 of this report.

Appendix B: Disclaimers

The data and information in this report ("Report"), which has been prepared by Quantum Capital Group (together with its affiliates, "Quantum"), are presented for informational purposes only. This Report shall not constitute an offer to sell or the solicitation of any offer to buy any interest, security, or investment product and may not be used or relied upon in connection with any such offer or sale of securities. An offer or solicitation in respect of any fund will be made only through offering materials prepared for such fund and will be subject to the terms and conditions contained therein. The information in this Report is only as current as the date indicated, and may be superseded by subsequent market events or for other reasons, and Quantum assumes no obligation to update the information herein. Nothing contained herein constitutes investment, legal, tax or other advice nor is it to be relied on in making an investment or other decision. This Report should not be viewed as a current or past recommendation or a solicitation of an offer to buy or sell any securities or to adopt any investment strategy. Each recipient agrees to not copy, reproduce or distribute the Report, in whole or in part, to any person or party without the prior written consent of Quantum and to keep permanently confidential all information contained herein not already public.

Certain information contained in this document constitutes "forward-looking statements" which can be identified by the use of forward-looking terminology such as "may," "will," "should," "expect," "anticipate," "target," "project," "estimate," "intend," "continue," "forecast," or "believe" or the negatives thereof or other variations thereon or comparable terminology. The forward-looking statements contained in this presentation are based on assumptions believed to be reasonable in light of the information presently available. More broadly, statements that do not relate strictly to historical or current facts are based on current expectations, estimates, projections, opinions or beliefs of Quantum and its affiliates or its sources of information as of the date of this Report. Actual events or results or actual performance may differ materially from those reflected or contemplated in such forward-looking statements due to various risks and uncertainties, many of which are beyond the control of Quantum. No assurance, representation or warranty is made by any person that any of such forward-looking statements will be achieved and no person should rely on such statements. Quantum has based these forward-looking statements on current expectations and assumptions about future events, taking into account all information currently known by Quantum. These expectations and assumptions are inherently subject to significant business, economic, competitive, regulatory and other risks and uncertainties; actual events are difficult to project and often depend upon factors that are beyond the control of Quantum and its affiliates. Additional risks of which Quantum is not currently aware could cause actual results to differ. The risks and uncertainties that may affect the operations, performance and results of Quantum's business and forward-looking statements include, but are not limited to, those set forth in this Report and in the documents Quantum files from time to time with the Securities and Exchange Commission. None of Quantum, any of its affiliates or any of their respective directors, officers, employees, partners, shareholders, advisors or agents makes any assurance, representation or warranty as to the accuracy of any of such forward-looking statements. Recipients of this presentation should carefully review the assumptions underlying any such forward-looking statements. Any forward-looking statement speaks only as of the date on which such statement is made, and Quantum assumes no obligation to correct or update any forward-looking statement, whether as a result of new information, future events or otherwise, except as required by law.

Certain information contained herein relating to any environmental, social and governance ("ESG") or other similar industry frameworks is subject to change, and no assurance can be given that Quantum will remain signatory, supporter, or member of such initiatives or other similar industry frameworks.

Certain information contained herein relating to any ESG-related goals, targets, intentions, or expectations, including with respect to any climate-related targets and related timelines, is subject to change and no assurance can be given that such goals, targets, intentions or expectations will be met. Further, statistics and metrics relating to ESG matters are estimates and may be based on assumptions or developing standards (including Quantum's internal standards and policies).

Similarly, there can be no assurance that Quantum's ESG policies and procedures as described in this Report will continue; such policies and procedures are subject to Quantum's fiduciary duties and applicable legal, regulatory, and contractual requirements and could change, even materially. Quantum is permitted to determine in its sole discretion, taking into account any applicable contractual commitments or regulatory requirements, that it is not feasible or practical to implement or complete certain of its ESG initiatives based on cost, timing or other considerations. Statements about ESG initiatives or practices related to portfolio companies do not apply in every instance and depend on factors including, but not limited to, the relevance or implementation status of an ESG initiative to or within the portfolio company; the nature and/or extent of investment in, ownership of, or control or influence exercised by Quantum with respect to the portfolio company; and other factors as determined by investment teams, corporate groups, asset management teams, portfolio operations teams, companies, investments, and/or businesses on a case-by-case basis. ESG factors are only some of the many factors Quantum considers in making an investment, and there is no guarantee that Quantum will successfully implement its ESG policies and procedures or that consideration of ESG factors will enhance long-term value and financial returns for limited partners or increase the ESG performance of investments. There is no guarantee that any of the steps taken by Quantum and/or third parties to mitigate, prevent, or otherwise address material ESG topics will be successful in preventing or mitigating impacts on returns, completed as expected or at all, or will apply to or continue to be implemented in the future. Similarly, to the extent Quantum engages with portfolio companies on ESG-related practices and potential enhancements thereto, there is no guarantee that such engagements will improve the financial or ESG performance of the investment. In addition, the act of selecting and evaluating material ESG factors is subjective by nature, and there is no guarantee that the criteria utilized or judgment exercised by Quantum will reflect the beliefs or values, internal policies or preferred practices of investors, other asset managers or with market trends.

Case studies presented herein were selected based on objective non-performance based criteria, are for illustrative purposes only, and are not intended to be a representative reflection of all portfolio companies or used as an indication of the current or future performance of Quantum's portfolio companies and do not purport to be a complete list thereof. There is no guarantee that Quantum will be able to identify similar investments in the future. It should not be assumed that such investments were or will ultimately be profitable or that investments made in the future will be comparable in quality or performance to the investments described herein. Unless otherwise stated, references to ESG initiatives and performance at portfolio companies are not intended to indicate that Quantum has materially contributed to such initiatives or performance. For instance, Quantum's ESG efforts may have been one of many factors – including such other factors as engagement by portfolio company management, advisors, and other third parties – contributing to the success described in each of the selected case studies. Further, references to the investments included in the illustrative case studies should not be construed as a recommendation of any particular investment or security. There can also be no assurance that the case studies described herein are not modified (perhaps materially) in the future or will lead to successful outcomes or improved portfolio company performance. Certain information was provided by third parties and certain statements reflect Quantum's beliefs as of the date hereof based on prior experience and certain assumptions that Quantum believes are reasonable, but may prove incorrect. Past performance is not necessarily indicative of future results. Investors may lose investment capital.

Recent technological advances in artificial intelligence and machine learning technologies (collectively, "AI"), as well as the rapid growth and widespread use of AI, have the potential to result in significant and disruptive changes in companies, sectors or industries, including those in which Quantum's funds invest, and any such changes could render Quantum's underwriting models obsolete or create new and unpredictable operational, legal and/or regulatory risks. Quantum, the funds and the portfolio companies could be further exposed to the risks of AI if third-party service providers or any counterparties, whether or not known to Quantum, use AI in their business activities. Quantum will not be able to control the use of AI in third-party products or services, including those provided by Quantum's and its affiliates' service providers. Additionally, AI technologies are highly reliant on the accuracy, adequacy, completeness and objectivity of their underlying data, and any inaccuracies, deficiencies or biases in this data could lead to errors affecting Quantum's decision-making and investment processes. AI and its applications continue to develop rapidly, and it is impossible to predict the future risks that have the potential to arise from such developments. Any of the foregoing factors could have a material and adverse effect on Quantum, the funds and the portfolio companies.

Statements about AI initiatives or practices related to portfolio companies do not apply in every instance and a portfolio company's use of AI will depend on factors including, but not limited to, the relevance or implementation of an AI initiative to or within the portfolio company as well as other factors. There can be no assurance that Quantum or its investments will be able to achieve any AI-related objective (in the time or manner set forth herein or at all). Actual results may be significantly different from the statements noted herein. Additionally, AI tools may produce inaccurate, misleading or incomplete responses that could lead to errors in certain business activities, which could have a negative impact on Quantum or on the performance of the Quantum funds and their portfolio companies. Further, ongoing and future regulatory actions with respect to AI generally or AI's use in any industry in particular may alter, perhaps to a materially adverse extent, the ability of Quantum, the Quantum funds or their portfolio companies to utilize AI in the manner it has to-date, and may have an adverse impact on the ability of Quantum, the Quantum funds or their portfolio companies to continue to operate as intended.

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