



Drive innovation in oil and gas exploration, production, and operations with AWS and NVIDIA

Discover how oil and gas companies can enhance application performance and accelerate exploration, production, and asset optimization using high performance computing (HPC) and AI.



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Driving transformation in oil and gas

Oil and gas companies are accelerating digital transformation to streamline upstream, midstream, and downstream operations, modernize aging infrastructure, and enhance the efficiency and safety of production processes.

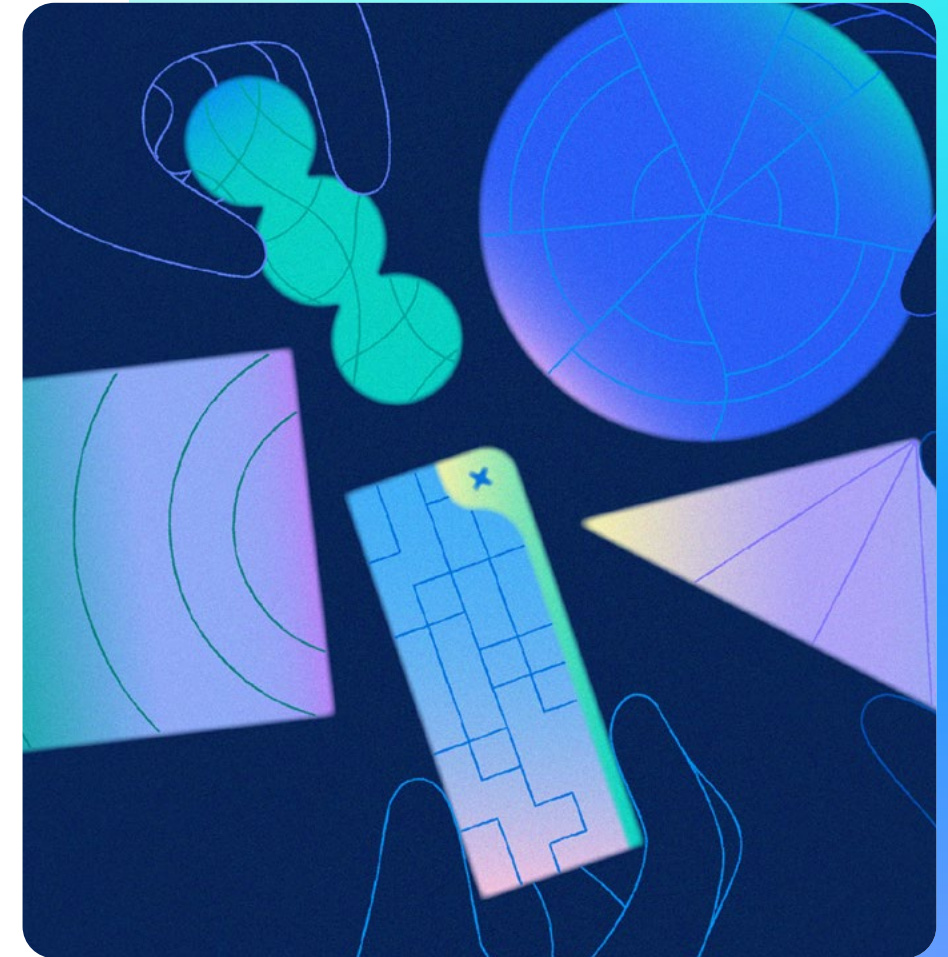
This industry-wide transformation has made HPC and AI increasingly valuable, but on-premises infrastructure can have its limitations as increasing compute capacity is required to deliver the power needed to run complex subsurface simulation workloads and massive datasets.

According to Deloitte's Oil and Gas Industry Outlook 2025, capital expenditure in the sector has risen 53 percent over the past four years. Net profit has also grown by nearly 16 percent, despite ongoing market uncertainty, driven by diligent efforts around capital discipline, customer centricity, and diversification into renewable energy sources.¹ Global investment in the transition to low-carbon energy also exceeded \$2 trillion for the first time in 2024, per Bloomberg Finance.²

This energy transition requires ongoing innovation to address critical industry pressures: keeping aging infrastructure running efficiently, advancing low-carbon initiatives, and managing investor and customer expectations.

Advanced AI technologies including agentic AI, are set to drive significant transformation in the oil and gas industry. By enabling intelligent automation, real-time decision support, and continuous performance monitoring, these technologies can enhance upstream exploration, streamline operational workflows, optimize complex supply chains, and improve asset reliability and safety.

To meet the energy demands of the future, oil and gas companies need cutting-edge solutions that deliver scalability, domain-specific workload acceleration, global connectivity, greater software agility, and optimized cost efficiency.



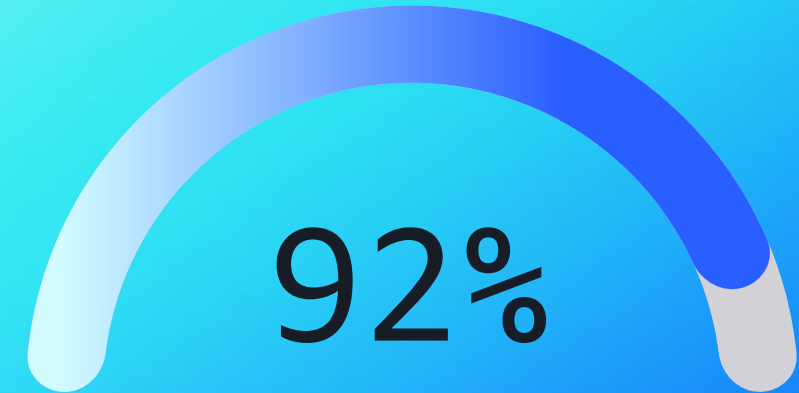
increase in capital expenditure within the oil and gas industry over the past four years

Key issues impacting oil and gas companies

Oil and gas companies face high exploration costs due in part to aging infrastructure, expensive equipment downtime, and safety risks. These organizations are also increasingly investing in alternative fuels and renewables. Seismic processing and reservoir simulation remain key use cases, often taking 12 to 24 months to complete and require large, specialized teams of reservoir engineers, petroleum engineers, geoscientists, and geophysicists.

Aging oil rigs, refineries, and processing facilities continue to drive up maintenance costs and increase the risk of unplanned shutdowns. Ensuring worker safety and operational efficiency remain top priorities as companies work to modernize systems and reduce emissions. As the pressure rises to meet evolving regulatory standards and consumer expectations, oil and gas companies are exploring more sustainable materials, improving energy efficiency, and integrating digital technologies to optimize performance across the energy supply chain.

By accelerating progress towards key goals, AI is driving a new phase of transformation in oil and gas. According to an Ernst & Young survey, over 92 percent of companies are already investing in AI or plan to soon, and this has already led to operational cost savings of up to 20 percent.³ Yet significant challenges remain across upstream, midstream, and downstream operations.



of companies are already
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savings of operational costs
with AI integration

Upstream use cases

Oil and gas usually fall into one of three areas – upstream, midstream, and downstream. Critical to the oil and gas industry is the ability to accelerate energy exploration and increase production with lower costs and emissions.

Upstream focuses on the exploration and production of fuels and natural gas, including emerging use cases for carbon capture and storage. Seismic imaging and reservoir simulations used in upstream processes can be accelerated by HPC which enables parallel processing, reducing the time taken for compute-intensive tasks and alleviating resource and processing constraints. Seismic interpretation is further enhanced by domain-specific seismic foundation models powered by gen AI, reducing the time it takes to analyze data for more accurate insights.

Agentic AI and retrieval augmented generation (RAG), used for predictive maintenance, enables systems to make real-time decisions and manage tasks autonomously to help resolve problems before they escalate. Advanced RAG solutions run complex drilling data sets including multimodal and numerical data, text, and diagrams, and support operational decision making and production optimization. AI-driven solutions help monitor industrial asset performance management (APM) remotely, predict high-risk situations to prevent disasters, and improve health and environmental safety.

These solutions use AI, ML, gen AI, and physically accurate industrial digital twins to offer online remote monitoring and real-time analytics for critical assets.

AWS and NVIDIA accelerate exploration and production

Amazon Web Services (AWS) and NVIDIA enable energy companies to drive stronger business outcomes across exploration and production. Secure, scalable infrastructure, and integrated services from AWS delivered from the cloud address challenges such as optimizing equipment health and streamlining workflows. Combined with industry-leading accelerators and development tools from NVIDIA, they help provide the infrastructure needed for building the most advanced industry applications.

Simulations for oil and gas exploration use large amounts of data such as highly sophisticated seismic surveys, algorithms, models, and more. Processing and analyzing this data requires enterprise-scale compute capacity.

With AWS and NVIDIA, geoscientists, geophysicists, petroleum engineers, and reservoir engineers can utilize NVIDIA GPU-based [Amazon Elastic Compute Cloud \(Amazon EC2\)](#) instances to accelerate reservoir simulation and seismic processing workloads, visualize multi-million cell 3D datasets faster, and optimize well placement to improve productivity and efficiency.



Upstream solutions

“The AWS Energy HPC Orchestrator (EHO) enables scientists and researchers to quickly run cloud-based HPC simulations, including seismic processing, CFD, reservoir modeling, and grid analysis. With EHO, energy companies can avoid managing underlying infrastructure, making HPC experimentation and scaling faster and cost-efficient.”

Marc Spieler, Senior Managing Director,
Energy, NVIDIA

Optimal compute performance and efficiency

The [Energy HPC Orchestrator \(EHO\)](#) from AWS is an innovative framework that democratizes access to advanced computing resources for energy companies of all sizes. It supports more efficient industry use of advanced computing resources, enables the integration of AI, ML, and gen AI, and automates compute resource allocation. EHO integrates spot instances and auto-scaling, and optimizes energy workflow orchestration to ensure cost efficiency and performance.

NVIDIA Energy Samples can be used to build derivative solutions on top of EHO. These samples provide a series of pre-optimized, AWS-native HPC templates to quickly build a cloud-native seismic application, and scale it with hundreds of NVIDIA GPU-based EC2 instances.

Simplified application development

The NVIDIA HPC SDK includes a comprehensive suite of compilers, libraries, and software tools essential to maximizing developer productivity and the performance and portability of HPC applications.

NVIDIA cuPyNumeric offers an accelerated computing library enabling scientists and researchers to harness GPU acceleration at cluster scale.

NVIDIA PhysX is an open-source, GPU accelerated, real-time multiphysics SDK.

NVIDIA IndeX is a 3D volumetric interactive visualization SDK that allows scientists and researchers to visualize and interact with massive datasets.

Efficient subsurface workflows

[Energy Data Insights \(EDI\)](#) on AWS enables energy companies to easily deploy, manage, and operate subsurface data management platforms, in compliance with OSDU technical standards.

NVIDIA PhysicsNeMo, a framework for building physics AI models at scale running on AWS, accelerates modeling of subsurface conditions supporting the creation and validation of large-scale digital twin models across various physics domains—from exploration sites to production reservoirs.

Modernized operational data access

[Production Monitoring & Surveillance](#) on AWS standardizes how data is brought into the cloud from physical infrastructure. Build a cloud-native data lake, retaining flexibility on choice of visualization and analytical workloads.

Optimized equipment health

[Equipment Health & Performance Optimization](#) solution on AWS delivers real-time visibility on equipment health and prediction of failure, days or weeks ahead for proactive maintenance.

Unified drilling data

[Drilling & Completion Data & Analytics](#) leverages AWS managed services to ingest, store, catalog, process, and analyze well construction data. Significantly reduce well design and planning time and decrease non-productive time through improved data availability and automated models.

AI training and deployment

[NVIDIA AI Enterprise](#), available in AWS Marketplace, accelerates and simplifies the development, deployment, and scaling of AI applications through a cloud-native suite of software tools, libraries, and frameworks.

NVIDIA Metropolis is a vision AI application platform and partner ecosystem that simplifies the development, deployment, and scalability of visual AI agents.

Midstream and downstream use cases

Midstream is responsible for the transportation and logistics that move unrefined oil and gas through pipelines and tanker ships to refineries for product processing. Processed oil and gas are then moved downstream away from refineries to fuel stations and customers for commercial use.

Extended Reality (XR) technologies like augmented and virtual reality are used to enhance training, improve safety, and streamline operations. XR application development requires a combination of powerful hardware and specialized software tools to support remote inspections, maintenance, and problem resolution.

Gen AI is reshaping midstream operations by analyzing data from inline inspection tools and other sources to protect pipeline integrity. It improves transportation by analyzing hundreds of route combinations that factor in capacity, demand, scheduling, logistics, and regulations to speed up deliveries. It is also used in health and safety to detect issues like real-time leaks and for dispatching crews according to risk level and availability.

Furthermore, energy trading is being transformed by gen AI through automation, enhanced forecasting, and data-driven decision making. It uses natural language processing, ML, and real-time analytics to streamline processes, reduce risks, and uncover new opportunities.

Downstream, AI powers logistics optimization for fueling stations and improves customer service with analytics using data collected from video, imaging, and mapping data while harnessing ML and deep learning. Gen AI enhances predictive maintenance in downstream operations by analyzing real-time and synthetic data to detect anomalies and optimize maintenance schedules. Digital twin simulations enable risk-free scenario testing, reducing downtime, and improving safety and efficiency.

AWS and NVIDIA drive production and optimize performance

Logistics operations today are still largely managed through manual processes, increasing both financial and operational risk for energy companies. AWS and NVIDIA streamline logistics operations with digital twins and data tools to optimize assets, enabling real-time anomaly detection, AI-driven routing, and energy-specific models.

Together, AWS and NVIDIA enable smarter, faster decision-making and drive digital transformation across the energy value chain.



Midstream and downstream solutions

Real-time visibility into field work

Manual workflows to manage critical activities slow down efficiency and response times. [Connected Field Work](#) solution on AWS provides real-time visibility into field-critical activities to improve how personnel track, monitor, and collaborate on operational processes, so tasks can be completed accurately and safely.

Immersive digital twins and real-time AI-driven simulations with NVIDIA Metropolis help visualize, monitor, and predict operational performance—supporting downstream scenarios such as refinery mechanics, logistics optimization, and facility modeling.

Improved hydrocarbon logistics

[Downstream Logistics Optimization](#) on AWS is a cloud-native solution to improve the tracking, analysis, forecasting, and optimization of hydrocarbon logistics operations. Combining it with NVIDIA software tools and accelerated GPUs enhances AI, ML, and analytics workloads enabling scalable, high-performance logistics forecasting, simulations, and decision-making systems.

Decision optimization and linear routing

NVIDIA cuOpt is an open-source, GPU-accelerated solver for decision optimization, excelling in mixed-integer linear programming, linear programming, and vehicle routing problems. Designed to tackle large-scale problems with millions of variables and constraints, cuOpt enables near-real-time optimization, driving significant cost savings.

Greater value from industrial data

[Refinery Monitoring & Surveillance](#) on AWS provides a standardized foundation for accessing and managing disparate sources of refinery and petrochemical data. Integrating NVIDIA GPUs and platforms like NVIDIA AI Enterprise and NVIDIA Metropolis on AWS enables advanced AI analytics, vision intelligence, and high performance processing at scale.

Better yields through optimization

[Process Optimization](#) on AWS leverages AI, ML, and digital twin simulations for actionable insights, predictive improvements, and reduced emissions. Training, inference, and simulations can be accelerated using NVIDIA GPUs and NVIDIA software on AWS to deliver high performance optimization for computer vision, digital twins, and other large-scale simulations.

The AWS and NVIDIA advantage

AWS and NVIDIA have collaborated for over 15 years to continually deliver powerful, cost-effective, and flexible accelerated computing solutions for energy industry customers. AWS and NVIDIA deliver industry-leading accelerated computing hardware and software with the scale, stability, and security you require to run AI workloads with confidence. AWS for Energy and Utilities also offers deep industry expertise and extensive energy infrastructure knowledge.

Boost application performance and enable innovation

The combination of AWS's global reach, secure and reliable cloud infrastructure, and breadth of services, accelerated by NVIDIA's full-stack computing platform, provides performance and an end-to-end software stack for AI and accelerated computing in energy.

Transform energy operations

Organizations can solve challenges like predictive maintenance and data analytics at scale, with AWS energy solutions running on high-performance Amazon EC2 instances accelerated by NVIDIA. Or build innovative applications by integrating AWS services for ML, gen AI, and HPC orchestration, together with NVIDIA AI Enterprise software, NVIDIA NIM microservices, and libraries.

Accelerate the clean energy transition

Unlock the innovation and efficiency needed to enable energy initiatives, with cloud-to-edge gen AI applications developed by innovative AI startups, easily accessible through the AWS Energy HPC Orchestrator and the NVIDIA AI Enterprise platform available in AWS Marketplace.



How to get started

AWS and NVIDIA combine decades of cloud and AI expertise to guide your success from concept to production. Leading energy companies can address many of their key challenges from AI and accelerated computing with AWS and NVIDIA to reduce operating costs, improve profitability, enhance worker safety, and lower environmental impact.

AWS and NVIDIA give you the freedom to choose how you build and deploy AI—with optimized solutions at every step of your journey. Oil and gas companies can harness the combined power of accelerated computing and AI to modernize infrastructure, optimize operations, and unlock new insights from their data.

[Learn more →](#)

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