



DIGITAL REPORT

TRANSFORMING ENERGY WITH **AI** AND **CLOUD TECHNOLOGIES**

IN ASSOCIATION WITH:



A woman with dark curly hair tied back, wearing glasses, a yellow and white striped shirt, and a brown cardigan, is sitting at a desk in a dimly lit office at night. She is looking at a computer screen, with her hand resting on her chin in a thoughtful pose. The background is blurred, showing office equipment and warm ambient lighting.

TRANSFORMING ENERGY WITH A CLOUD TECHNO

AI AND TECHNOLOGIES

TGS' Wadii El Karkouri reveals how the world's largest energy data company is leveraging digital innovation to revolutionise subsurface exploration

As demand for energy rises and the industry faces increasing pressure to operate more efficiently, companies are turning to AI and cloud

technologies to transform their operations. At the forefront of this transformation is TGS, the world's largest energy data company. TGS has built its business on acquiring, processing and selling subsurface data to help oil and gas companies make informed investment decisions. Under the leadership of Wadii El Karkouri, Executive Vice President of Imaging & Technology, TGS is evolving from a seismic company enabled by technology into something far more ambitious.

"We're turning it into a technology company enabled by seismic data," Wadii explains.

Wadii joined the business in 2024 from AWS following a career predominantly at the intersection of energy and technology, with more than two decades at SLB preceded by a stint at TotalEnergies. His appointment represents a strategic bet on the convergence of energy expertise and digital innovation.



**Wadii El Karkouri,
Executive Vice President,
Imaging and Technology,
TGS**

To underpin this shift, TGS has acquired numerous competitors over the last four decades, creating what Wadii describes as “pieces of Lego” – technology, people, knowledge and experience – that must be brought together.

TGS operates through four main business units. Its seismic data acquisition division owns expensive vessels worth up to US\$250m each that collect subsurface data using either streamer technology or ocean bottom nodes.

The processing and imaging division transforms raw seismic signals into three-dimensional subsurface maps, while a multi-client business model involves investing company funds to acquire data, then selling access to multiple energy companies.

The fourth and final division focuses on renewable energy, including wind farm site characterisation and solar asset management software – diversification that reflects the industry’s broader energy transition while maintaining focus on traditional hydrocarbon exploration.

Bridging gaps with technology

One of Wadii’s primary challenges involves bridging the generational divide within the oil and gas industry – a space that has been slow to adopt digital innovations.

His goal is to create a new generation of “oil and gas explorers and producers that are thinking digitally from the beginning”.

The challenge extends beyond individual attitudes to systemic issues within the energy sector. Wadii explains that economic cycles have become

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Wadii El Karkouri,
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more frequent and volatile, forcing companies to deliver faster returns on technology investments.

“The return on investment of R&D and technology is not the five to seven years that it was when I joined the industry,” he says. “It’s now more like 12 to 18 months.”

The impact of revolutionary data processing capabilities

TGS’ technological advantage begins with its massive subsurface data library, accumulated over the course of 44 years of global operations – Wadii thinks of it as Google Maps meets a digital twin – where you don’t just view the subsurface, you simulate it, interpret it with AI and make improved drilling decisions.

The extensive dataset enables TGS to develop what Wadii calls a “seismic foundation model” – essentially a Gen AI chatbot for subsurface exploration. The system can identify patterns and connections across different geological basins worldwide.

A portrait of Wadii El Karkouri, a middle-aged man with dark hair, wearing a white button-down shirt. He is smiling slightly and looking directly at the camera. His arms are crossed.

WADII EL KARKOURI

EXECUTIVE VICE PRESIDENT, IMAGING AND TECHNOLOGY

With over 25 years of leadership experience in the energy and technology industries, Wadii drives innovation and technological advancements in seismic processing, data analytics and digitalisation. Prior to joining TGS, he served in a range of leadership roles in SLB in the US, Africa, Asia, Europe and the Middle East, including Global Vice-President WesternGeco Geosolutions and Global Vice President WesternGeco Sales & Commercial. He has also worked as a Global Sales Director at AWS.



This level of knowledge and interconnectedness traditionally only existed in the minds of experienced geologists with decades behind them. Now, the foundation model aims to democratise this expertise, making sophisticated geological insights available through AI.

This, Wadii hopes, could accelerate discovery rates – all while reducing the industry's dependence on scarce human expertise.

The technical process begins at sea, where TGS vessels acquire data using airgun sources that generate sound waves. These waves travel through subsurface layers and return to sensors, creating detailed underground maps.

Modern satellite technology – including Starlink low-orbit systems – now enables real-time data transmission from vessels to cloud processing centres. This represents a significant improvement over previous methods, which involved transferring physical storage devices via helicopter.

How cloud computing transforms imaging capabilities

Once this data reaches the cloud, TGS applies advanced processing techniques to clean signals and remove various types of noise. Sophisticated imaging algorithms are then employed to convert time-based signals into depth-based geological maps.



Two key technologies – elastic full waveform inversion and reverse time migration – use intensive computational power to create accurate subsurface images. These techniques can reveal complex geological features like salt formations, faults and reservoir channels.

Wadii shares: “Because of advances in AI and digital technologies like the cloud, we are able to push the physics of imaging to a level never seen before, allowing energy companies to make better decisions, calculate ROI on their investments in drilling a new well or investing in new prospects and, hopefully, leading to better discoveries and more energy for the world.”

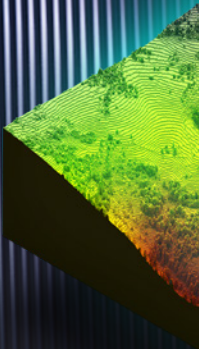
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Case Study

Geoscience Meets Cloud HPC: The Next Frontier of Innovation



Few computing challenges rival those found in geoscience and exploration workflows. Seismic imaging, full-waveform inversion and reservoir simulation are among the most computationally demanding workloads on Earth – on par with large-scale AI training and climate modelling. Even today, specialised geoscience systems occupy the second and third spots among the world’s most powerful privately held supercomputers.

While industries like finance and life sciences have already embraced cloud computing for high-performance workloads, the energy sector’s transition has been slower and more complex. The reasons are deeply technical.

1. RIGID LEGACY SYSTEMS

Most geoscience software was designed decades ago for fixed-size, on-premises supercomputers. These environments were optimised for tightly coupled parallelism and predictable hardware – not today’s elastic cloud infrastructure.

Cloud pricing favours rapid, on-demand scaling, yet many legacy applications lack the flexibility to start, stop or resize efficiently – reducing both performance and cost efficiency.

2. INTOLERANCE TO INTERRUPTIONS

Public clouds offer discounted spot instances – temporary compute nodes that can be reclaimed without notice. While ideal for AI or analytics workloads, traditional seismic or reservoir codes cannot tolerate such interruptions. Losing one node can invalidate hours of computation.

To capture the cloud’s economic advantage, fault tolerance and checkpointing must be engineered in, moving from static assumptions to resilient design.

3. THE DATA BOTTLENECK

A single seismic survey can hold tens to hundreds of terabytes of data that must be accessed by thousands of compute nodes simultaneously. This becomes difficult when file-based HPC systems meet object-based cloud storage.



Bridging this gap demands domain-aware I/O strategies, adaptive caching and hybrid data architectures that preserve performance while exploiting cloud scalability.

4. THE CLOUD'S HIDDEN LIMITS

Despite the promise of infinite scale, the cloud has physical limits.

At large sizes, geoscience workloads encounter real constraints – cluster size limits, network address exhaustion, data-transfer caps and regional capacity constraints. These limits only appear under extreme load, but for energy supercomputing, they are the norm, and thus unavoidable. Understanding and designing around them is key to building production-grade cloud HPC.

THE ROAD AHEAD

AI is rapidly transforming geoscience computing – from automating seismic interpretation to optimising reservoir modelling and production planning. But realising these gains requires HPC environments that are elastic, fault-tolerant, data-centric and AI-ready.

This shift is already visible in major industry collaborations uniting leading geoscience data providers, cloud hyperscalers and digital engineering specialists. Recent initiatives – such as the one we are leading at EPAM systems in conjunction with TGS

and AWS – show how re-architected cloud HPC platforms can deliver end-to-end seismic and subsurface workflows, seamlessly integrating AI, scalable compute and high-performance storage. The result: faster insights, higher efficiency and a markedly lower carbon footprint. These advances are setting a new template for energy operators seeking to modernise their compute-intensive environments.

Emerging orchestration frameworks can now enable multi-vendor interoperability, allowing workloads to move securely and efficiently across different clouds. For example, the Energy HPC Orchestrator (EHO), developed as a collaboration between EPAM Systems and AWS in partnership with several major oil and gas operators demonstrates how scalable job management, data movement and cost optimisation can be unified under a single control plane.

For operators, the implication is profound: HPC is no longer a fixed asset – it's an adaptive capability, accessible on demand and tuned to evolving exploration and production needs.

UNLOCK THE FULL POTENTIAL OF YOUR ENERGY WORKFLOWS WITH CLOUD HPC

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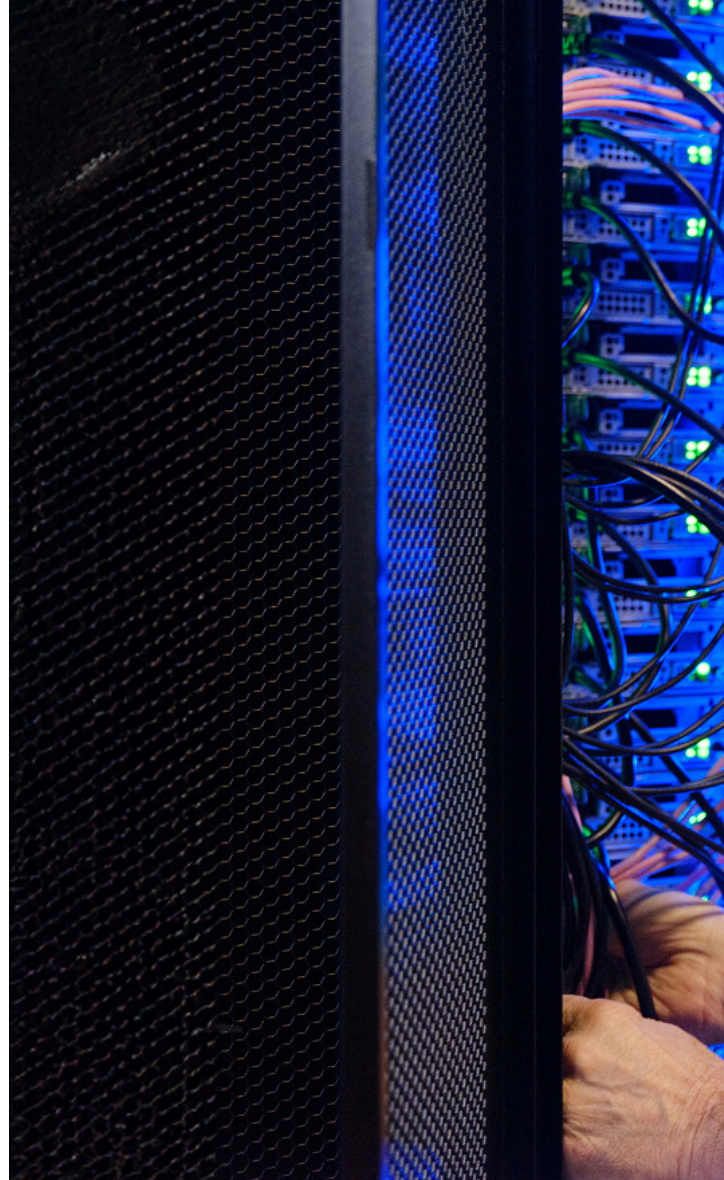
This shift does not come without challenges, however. The sheer volume of data TGS processes means careful organisation and standardisation is required. Wadii, using Netflix as an analogy, explains the need for consistent data formats that enable instant playback – like that of streaming services – to ensure the approach works.

“Because Netflix was near enough born on the cloud, all its movies are in the same format,” he explains. “When you subscribe and log in, things play at the touch of a button. But imagine Netflix was born 50 years ago and they acquired Blockbuster and data on tapes – they’d have a mixture of formats. It would’ve been a huge amount of work to get to where they are today, or reformatting all that content probably wouldn’t have even been possible.

“The journey we’re going on is similar. We’re working on tidying up all our legacy data and bringing it onto the cloud so that we can enable new workflows that will generate value for our clients. This is a challenge we want to overcome for ourselves as TGS, but we also offer this as a service to various energy companies. We have contracts in place with large energy companies to support them through this process.”

Strategic partnerships drive innovation

TGS’ digital transformation relies heavily on strategic partnerships across the technology ecosystem. The company works with cloud providers, like Google Cloud and AWS, to modernise its IT infrastructure and processing capabilities.



EPAM, a global IT services company, serves as TGS’ primary systems integrator for workflow modernisation and architecture updates, while cybersecurity firm Wiz monitors the company’s cloud footprint against potential threats.

“The oil and gas industry is always a target for various malicious organisations,” Wadii shares, emphasising the importance of collaboration and partnerships. “We have to make sure we are top-notch, and these partnerships do that.”

On top of this, Wadii and TGS worked tirelessly to achieve the ISO 27001 certification, demonstrating robust cybersecurity practices to clients and partners “and readiness in case such an event happens”.



These partnerships reflect a broader industry trend toward collaboration between traditional energy companies and technology specialists. Wadii emphasises that this is because no single organisation – even one like TGS with decades of specialised expertise – possesses all the knowledge needed for comprehensive digital transformation.

TGS also participates in industry standards initiatives like the Open Group OSDU Forum, aiming to create common data formats and exchange protocols across the energy sector.

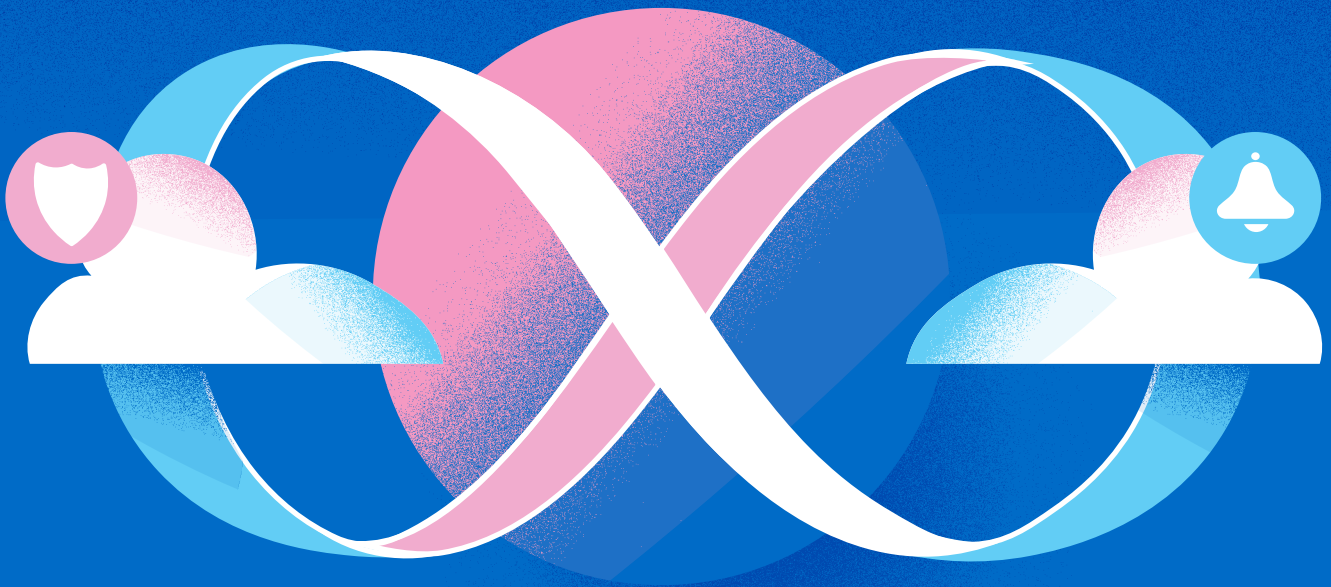
What's more, TGS has contributed its MDIO streaming format as open-source software, enabling efficient data access without creating multiple copies.

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Emphasising responsible AI implementation

As TGS deploys AI across its operations, the company has developed comprehensive governance frameworks for responsible AI use. This includes policies balancing innovation with data protection and regulatory compliance requirements.

“We’ve developed a Gen AI policy that ensures AI is deployed responsibly, balancing innovation with controls around data use, IP protection and regulatory compliance,” Wadii reveals. “Beyond policy, we are embedding AI into workflows in a controlled and transparent way, for example, assisting teams with efficiency and innovation while maintaining clear boundaries around confidential and sensitive data.

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efficiency, integration post-merger and accelerated insight delivery for clients.”

Security considerations are built into TGS’ cloud migration strategy from the outset. As the company moves high-performance computing workloads from on-premises systems to AWS, it implements cloud-native security controls and zero-trust principles.

Given the sensitivity of seismic and subsurface data, TGS treats cybersecurity as integral to business continuity and client trust rather than merely an IT function.

The importance of industry collaboration

Beyond technology partnerships, TGS maintains extensive relationships with universities and research consortia. These collaborations provide access to cutting-edge research and insights from other industries that could benefit energy exploration.

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Wadii sees potential for cross-industry knowledge transfer, where subsurface expertise could generate value in manufacturing, sports and other sectors.

“That’s never been done before, as far as I know, in our industry,” he says.

The company also works closely with governments worldwide, helping develop local capabilities and organising regulatory frameworks for energy block auctions. TGS invests hundreds of millions of dollars acquiring data in various countries to help market their hydrocarbon potential.

As well as this, client relationships remain central to TGS’ strategy, with regular discussions with major energy companies. These conversations help TGS understand industry priorities and budget constraints.

Wadii continues: “We like to make sure we understand what their priorities are, what their challenges are, what they’re trying to achieve in the next 12 to 24 months and how their budgets align with their aspiration so we can discuss how we can use technology, data and knowledge to help them get the maximum return. That’s the key item today.”



The future of energy exploration

Wadii envisions TGS enabling the energy industry to achieve efficiency improvements comparable to those seen in finance, pharmaceuticals and manufacturing through digital transformation.

The company’s ambition focuses on “enabling energy for all by unlocking vital, data-driven solutions and knowledge” and, with the world’s population approaching eight billion people and energy poverty affecting roughly one billion, demand for all energy sources will continue growing.



“We need all sources of energy to contribute to this energy portfolio – whether it’s oil and gas, wind, solar or hydrogen,” he explains. “There are a lot of other things that are still in research that will be able to enable this energy for the future of society. We need technology and data so we can invest the right amount of money in the right places and get the best return – all with minimal carbon footprint.”

This balanced approach recognises both the ongoing need for hydrocarbon resources and the importance of renewable energy development.

TGS’ diversification into wind and solar markets reflects this comprehensive energy strategy.

TGS aims to continue growing while helping transform upstream workflows to be “better, faster and much more cost effective than today”. Success requires integrating technology, human expertise and comprehensive subsurface data to enable better energy discoveries. “We hope to be able to completely change the oil and gas, and energy industries going forward,” Wadii concludes. ●



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