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The Energy, Resources & Industrials Generative AI Dossier

A selection of high-impact use cases

By Deloitte AI Institute

www.deloitte.com/us/generative-ai-dossier

Six key modalities

One of the primary differences between more traditional AI and Generative AI is that the latter can create novel output that appears to be generated by humans. The coherent writing and hyper-realistic images that have captured public and business interest are examples of Generative AI models outputting data in ways once only possible with human thought, creativity, and effort. Today, Generative AI models can create outputs in six key modalities.

Text

Written language outputs presented in an accessible tone and quality, with details and complexity aligned with the user's needs.

Examples include summarizing documents, writing customer-facing materials, and explaining complex topics in natural language.

Code

Computer code in a variety of programming languages with the capacity to autonomously summarize, document, and annotate the code for human developers.

Examples include generating code from natural language descriptions and autonomously maintaining code across different platforms.

Audio

Much like textual outputs, audio outputted in natural, conversational, and even colloquial styles with the capacity to rapidly shift among languages, tone, and degrees of complexity.

Examples include Generative AI-powered call centers and troubleshooting support for technicians in the field.

Image

Textual or visual prompts lead the model to create images with varying degrees of realism, variability, and "creativity."

Examples include simulating how a product might look in a customer's home and reconstructing an accident scene to assess insurance claims and liability.

Video

Similar to imagery, Generative AI models can take user prompts and output videos, with scenes, people, and objects that are entirely fictitious and created by the model.

Examples include autonomously generating marketing videos to showcase a new product and simulating dangerous scenarios for safety training.

3D/Specialized

From text or two-dimensional inputs (e.g., images), models can extrapolate and generate data representing 3D objects.

Examples include creating virtual renderings in an omniverse environment and AI-assisted prototyping and design in a purely virtual space.

By understanding these modalities, organizations are empowered to think through and better understand the kinds of benefits Generative AI could permit. For each use case described in this dossier, there may be more than one value-driving modality. A chatbot text output could be presented as simulated audio; a generated image could be extended into a video. Ultimately, the Generative AI use case and the value the organization seeks will determine which output modalities can contribute the greatest advantages and outcomes.

Broad categories of value capture from Generative AI

The value that Generative AI use cases can enable can be conceived across six dimensions: cost reduction, process efficiency, growth, innovation, discovery and insights, and government citizen services. To be sure, a single use case can drive more than one value capture, but to help paint the vision for how Generative AI can be used to move the needle on competitive differentiators and operational excellence, the use cases described in this dossier are each associated with a primary value capture.

Cost reduction

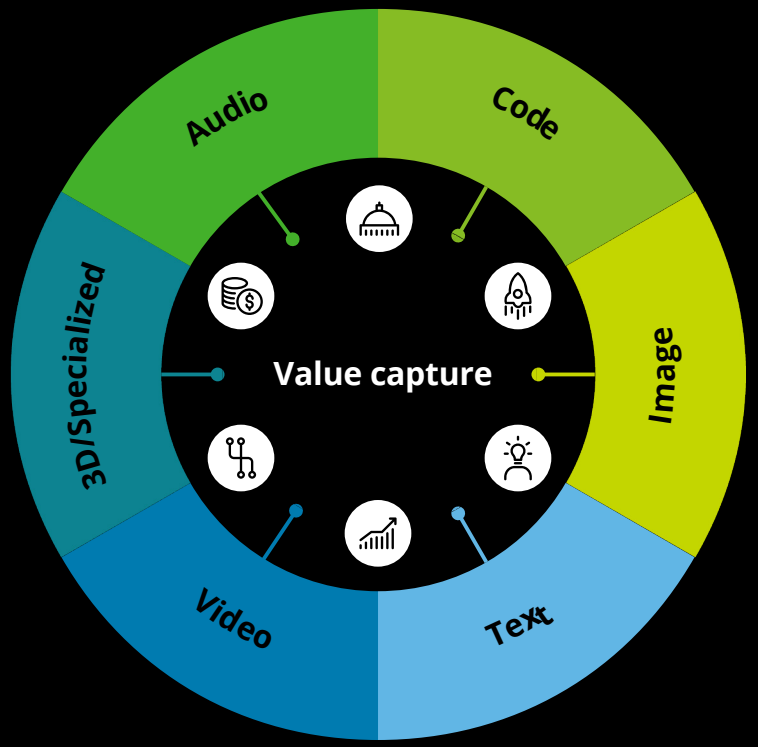
Reduce cost, typically by 30% or greater, primarily through automating job functions and then undertaking job substitutions

Process efficiency

Create process efficiencies through automating standard tasks and reducing manual interventions

Growth

Increase revenue generation through hyper-personalized marketing for target customers



Government citizen services

Increase accuracy of various federal and local programs and create easier access for at-risk populations

New discovery and insights

Uncover new ideas, insights, and questions and generally unleash creativity

Accelerating innovation

Increase the pace of new product or new service development and speedier go-to-market

Companies in the Energy, Resources, & Industrials (ER&I) industry face challenges related to energy security, affordability, profitability, and the transition towards a cleaner and sustainable future. Adopting Generative AI presents an attractive opportunity to help address these critical areas. Integrating Generative AI across the industry can lead to cost avoidance, operational efficiencies and resilience, and reduced emissions.

Historically, the ER&I industry has tended to take a conservative approach in embracing novel technologies, owing to the investment required to access new benefits while mitigating new risks. Consequently, companies may be hesitant to become early adopters of Generative AI. Yet, incumbent firms (particularly in construction, mining, and energy production) may hold an inherent advantage in this domain, as they possess exclusive and proprietary data that can be used to finely calibrate Generative AI models for specific requirements and value-driving use cases. This grants them the potential to take a leading market position when leveraging Generative AI models.

There is increasing pressure on companies in this industry to transition to more sustainable and environmentally friendly practices. This pressure is exacerbated by the global shift towards renewables and the need to diversify the energy mix. Generative AI may hold transformative potential in this regard. For example, Generative AI is revolutionizing resource exploration and extraction processes. Resource-rich areas can be quickly identified by capitalizing on vast amounts of geological and geophysical data. As an example, Generative AI could be employed by Oil and Gas companies to overcome the complex logistical challenges of offshore exploration. Synthetic seismic data generation and generative modelling of hydrocarbon reservoirs can optimize

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exploration efforts and increase resource extraction efficiency while limiting disturbance to the surrounding environment. By optimizing energy usage, minimizing waste, and supporting the development of eco-friendly technologies, by automating certain parts of the design process, Generative AI can contribute to a more sustainable and responsible approach to resource extraction and industrial operations.

Initiating the adoption of Generative AI at this juncture goes beyond merely gaining a competitive edge in the present. It also entails establishing a foundation for future growth by investing in the workforce. Contemplating the ER&I industry's future, Generative AI will likely assume a central role in optimizing and mitigating health and safety risks by generating worksite-specific safety training that replicates real-world settings and critical scenarios. As companies transition to the environmentally sustainable business model, Generative AI could develop real-time, bespoke training materials that support workforce transition and adoption of sustainable practices.

By embarking on the exploration and implementation of Generative AI now, companies can acquire valuable insights, adapt to its nuances, and evolve alongside the advancing technology. This strategic approach will position organizations to leverage the full capabilities of Generative AI as it reaches maturity.

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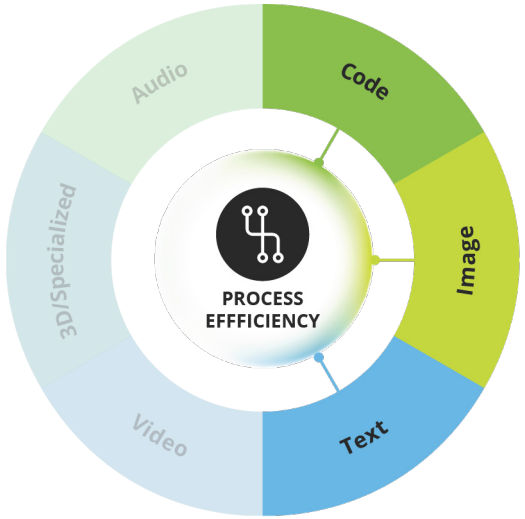
Keeping the equipment healthy

(Asset Maintenance Planning)

Generative AI in asset maintenance planning can improve equipment uptime, reduce maintenance costs, and enhance operational efficiency.



Issue/opportunity

In mining and oil and gas operations, maintenance planning helps prevent premature equipment failure, costly repairs and replacements, and extends the life of an asset. Facing near- and long-term constraints and factors, maintenance plans and the subsequent downstream processes can be changed to align with production, in response to resource availability, or because of unexpected events. Making maintenance plan alterations, however, can be costly and labor intensive.

How Generative AI can help

Continuous improvement
Generative AI can be used to reconcile lessons learned from prior shutdowns, identify opportunities for maintenance alignment, provide planners with the information needed to challenge assumptions on maintenance alignment, and develop strategies to minimize the impact across the system.

Optimal maintenance scheduling
Generative AI helps optimize maintenance schedules by weighing operational factors (e.g., equipment use, production requirements, and maintenance costs), recommending the most efficient and cost-effective schedules, and analyzing equipment use and performance data to minimize downtime and maximize equipment availability.

Simulation and optimization
Generative AI can simulate maintenance scenarios and evaluate the impact of maintenance strategies on equipment performance, productivity, and operational efficiency. This helps reveal the most effective maintenance approaches and optimizes resource allocation for maintenance activities.

Keeping the equipment healthy

Managing risk and promoting trust

Robust and reliable

Generative AI applications for asset maintenance planning depend on the quality of the data. Data that is incorrect, incomplete, or is not representative of the current operational environment or maintenance practices can lead to a suboptimal and potentially inappropriate maintenance plans that may even be detrimental to asset health management and future maintenance planning activities.

Accountable

There is no machine substitute for a human asset maintenance planners' knowledge, experience, and expertise. Overreliance on AI-generated outputs without critical human review may lead to important contextual factors and valuable insights being overlooked.

Safe and secure

Generative AI models may struggle to account for the uncertainties inherent in asset maintenance planning, like unexpected equipment failures or changing production requirements. Suboptimal or unrealistic Generative AI recommendations due to overfitting can lead to inaccuracies or poor performance when applied to real-world maintenance scenarios. The degree of human intervention and oversight needed must be considered in the design phase of the solution. This is especially true in intricate operational constraints which may prevent Generative AI from providing accurate and feasible solutions.

Potential benefits

Proactive cost improvements
Maintenance plans can be dynamically altered at different time scales in response to changes in upstream plans, which not only helps minimize the impact of down time but also maximize the use of available resources for asset maintenance.

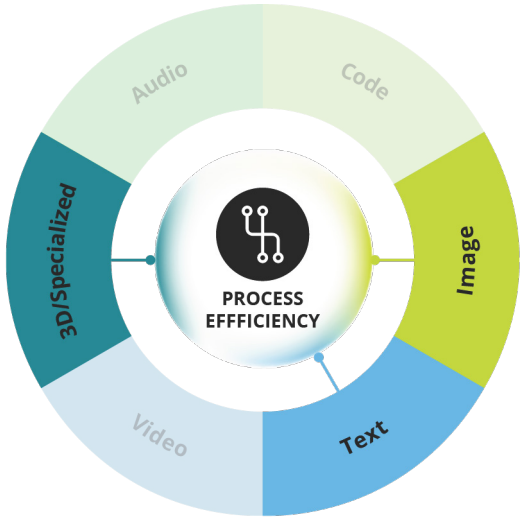
Increased volume delivery
Improved alignment of planned maintenance and production helps increase volume without compromising asset management strategies.

Greater health and safety
Optimal resource allocation, accommodation management, and shutdown duration all support occupational health and safety outcomes.

Optimize the design

(Site Design Generation)

Generative AI can support the development of site plans by automating aspects of the design process, providing designers with new possibilities and reducing the associated time and cost.



Issue/opportunity

Site planning is a multi-stage, iterative process to optimize cost, efficiency, and safety, but it is also an expensive and time-consuming exercise involving numerous stakeholders and third-party specialists. Site planning can require surveys in remote, sometimes hostile locations. Forecasting near- and long-term impacts involves assessing a multitude of factors, and site-specific activities such as topological and geological surveying can be labor intensive and expensive.

How Generative AI can help

Automated layout generation
Designers can use Generative AI to analyze site constraints, design requirements, and input from engineers to quickly generate layout options for site plans that consider factors such as zoning regulations, operational use, and user preferences.

Design optimization
Generative AI can help optimize site plans by analyzing parameters like solar orientation, traffic flow, and accessibility to suggest optimal infrastructure placements. This can help improve energy efficiency, support better space utilization, and enhance the user experience.

Efficient documentation and annotation By analyzing design elements and structures in the generated plans, Generative AI can automatically annotate the plans with relevant information, such as dimensions, materials, and specifications. This automation could save designers considerable time and effort, allowing them to focus on higher-level design tasks.

Optimize the design

Managing risk and promoting trust

Responsible

Generative AI for design optimization may focus primarily on efficiencies, such as cost reduction or time savings, while potentially neglecting other important considerations, such as environmental sustainability, community impact, or long-term adaptability. The model should be configured to balance multiple objectives and prioritize trade-offs to achieve better overall outcomes.

Accountable

Using Generative AI for site planning raises legal considerations around intellectual property, ownership of AI-generated designs, liability for design flaws, and privacy restrictions for sensitive or proprietary data.

Potential benefits

Acceleration with automation
Using Generative AI for site planning can accelerate the completion of time-consuming processes.

Discovering new solutions
With Generative AI quickly creating a variety of site designs, the planning process can include a greater diversity of designs and the promotion of innovative planning solutions.

Reducing risk
Generative AI can simulate and analyze potential hazards and safety risks in site plans. AI-generated planning would consider factors such as weather events, traffic patterns, and emergency response routes. It could propose alternative design options to proactively minimize risks to safety and reduce potential property damages in case of unforeseen events.

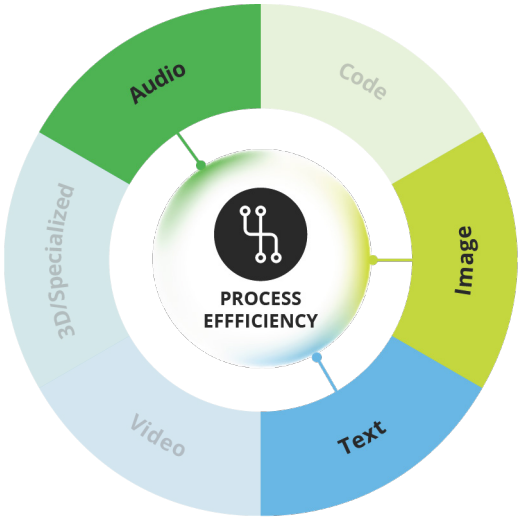
A helping hand in the field

(Virtual Field Assistant for Engineers)

A Generative AI-enabled virtual field assistant can provide engineers with on-demand access to engineering knowledge and support in problem solving, improving efficiency, productivity, and decision-making capabilities.

Issue/opportunity

Engineers sometimes work in remote or challenging environments, and they regularly experience information challenges, such as a lack of manuals or the need to localize the source of a problem. Because of this, engineers may need to seek further guidance and return to the site at a later time.



How Generative AI can help

Easily accessible technical information
A Generative-AI enabled virtual field assistant can serve as a reference tool and provide quick access to a vast amount of technical information. As well as delivering relevant information and directing engineers to appropriate resources, a virtual field assistant can help with problem solving by responding to questions about specific engineering concepts, principles, or calculations.

Troubleshooting and diagnostics
When encountering issues or challenges in the field, engineers can describe the problem to a virtual field assistant, and it will return appropriate questions to identify the cause or provide step-by-step guidance for resolution.

A helping hand in the field

Managing risk and promoting trust

Robust and reliable

A virtual assistant's accuracy depends on the quality of its training data, and if the data is inaccurate or outdated, its incorrect outputs could lead to potential harms to the engineer, damage to equipment, or operational downtime. In addition, Generative AI's potential to hallucinate outputs means the virtual assistant may make recommendations that are erroneous or contextually inappropriate. The potential for misinterpretation or misinformation underscores the importance of engineers cross-verifying information, especially regarding safety-critical processes or decisions.

Responsible

With a typically reliable virtual assistant, engineers may become overly dependent on the assistant and fail to balance its output with their own skills and judgement. In complex situations requiring creative problem solving or critical thinking, relying solely on the assistant's responses may be insufficient.

Accountable

If incorrect information or advice from the virtual field assistant leads to an accident or operational failure, there may be complex liability issues to resolve. Clear guidelines and procedures for addressing these situations should be established as a part of model governance.

Potential benefits

Cost savings
By giving engineers an information and troubleshooting resource, the organization can improve the efficiency of its operations, with corresponding value for cost savings.

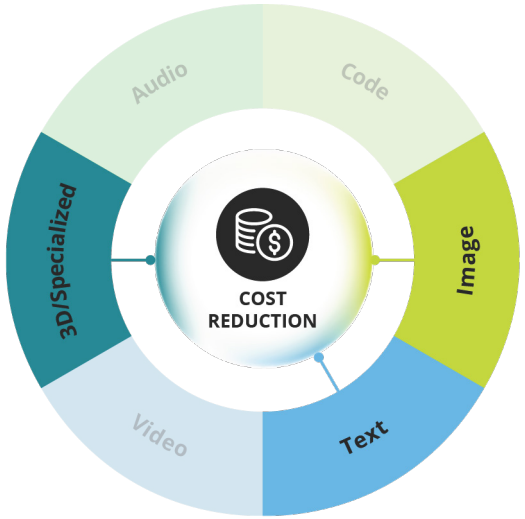
Improved effectiveness in the field
Informed problem solving and decision-making supports task completion with minimal remediation.

Occupational health
By more rapidly addressing issues with the aid of a virtual assistant, engineers may spend less time in the field exposed to potential environmental hazards.

Peering below the surface

(Hydrocarbon Reservoir Exploration)

Generative AI can be used to optimize exploration success rates, reduce costs, and mitigate risks associated with hydrocarbon reservoir location and characterization.



Issue/opportunity

Oil and gas exploration involves a high degree of uncertainty and risk. Advanced technologies and extensive data analysis are needed to navigate the subsurface and accurately locate and characterize reservoirs. Extracting oil and gas from underground reservoirs requires advanced drilling techniques and technologies, and harsh environmental conditions, deep water, and complex logistics make offshore exploration difficult. As result, exploration is a capital-intensive and time-consuming process involving multiple stages of seismic surveys, analysis, drilling, and testing.

How Generative AI can help

Seismic data analysis
To overcome incomplete, low volume, or poor-quality seismic data, Generative AI can support enhanced data analysis and interpretation. Generative AI could be used to generate new data samples that resemble the patterns and characteristics of the existing seismic data, addresses missing or incomplete seismic data, improve data quality through denoising or resolution enhancement, and more effectively interpret complex data patterns.

Reservoir characterization
By analyzing data sources such as well logs, core samples, and production data, Generative AI can create models that simulate the more complete behaviors of hydrocarbon reservoirs. This enables a better understanding of the reservoir dynamics, which helps optimize production strategies and improve recovery rates.

Peering below the surface

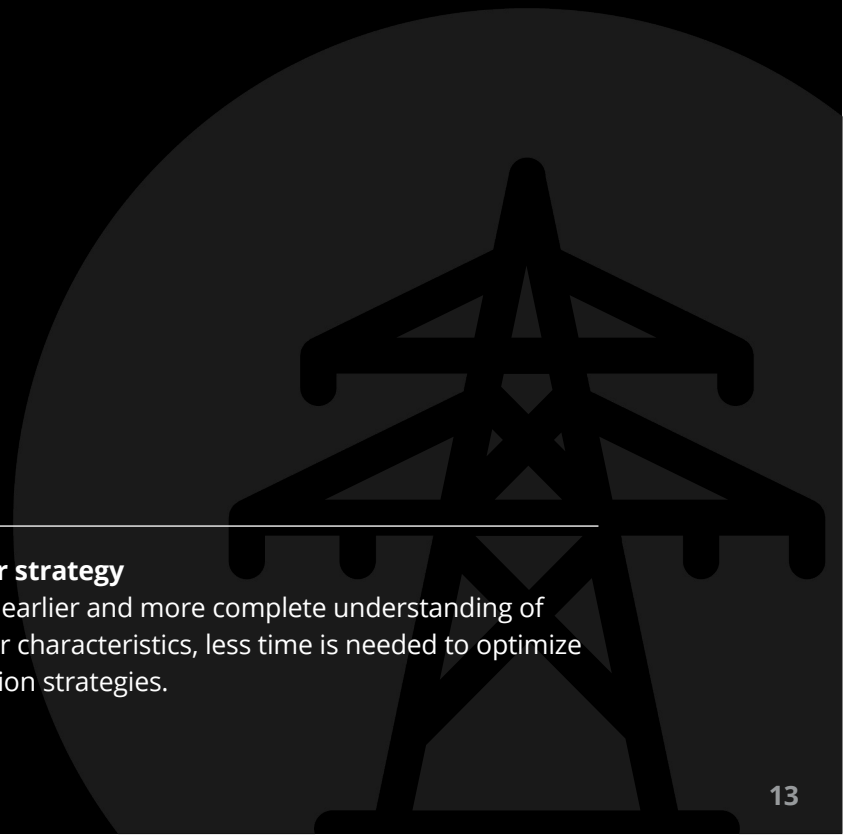
Managing risk and promoting trust

Reliable

False positives or misinterpretations may result in costly and time-consuming drilling operations that do not yield productive reservoirs, making human expertise crucial to validating insights and decision-making.

Robust

Generative AI models may fail to consider critical factors or geological nuances that human geoscientists would recognize and so the model fails to contextualize the data when generating outputs. Without contextual understanding, the AI-generated models and interpretations may lack accuracy or fail to capture the full complexity of reservoirs.



Potential benefits

Informed investments and decisions
A deeper, more complete understanding of the characteristics of hydrocarbon reservoirs reduces the degree of uncertainty and supports investment decisions.

Amplifying exploration
Improved data quality supports more accurate subsurface modeling, imaging, and structure characterization, which translates to an increased ability to accurately locate hydrocarbon reservoirs.

Smarter strategy
With an earlier and more complete understanding of reservoir characteristics, less time is needed to optimize production strategies.

Conclusion

Getting the most value from Generative AI

These are the early days of Generative AI, but the technology is rapidly maturing. As it does, organizations in every industry will probe how this type of AI can contribute to their business and open doors to transformative opportunities. As such, an important part of understanding and working with Generative AI is shaping the vision for the future, acknowledging both the potential benefits and the risks.

In this Generative AI-enabled era, governance and risk mitigation are business imperatives. The challenges organizations face with traditional AI are amplified in this new arena. A commitment to the trustworthy development and use of Generative AI will only become more important as the capabilities grow and governing bodies shape rules for their application.

Still, there is also a risk in waiting to embrace Generative AI. The use cases described in this dossier are a starting point for exploring how this powerful technology can be used to improve the enterprise today and prepare it to lead in the future.

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