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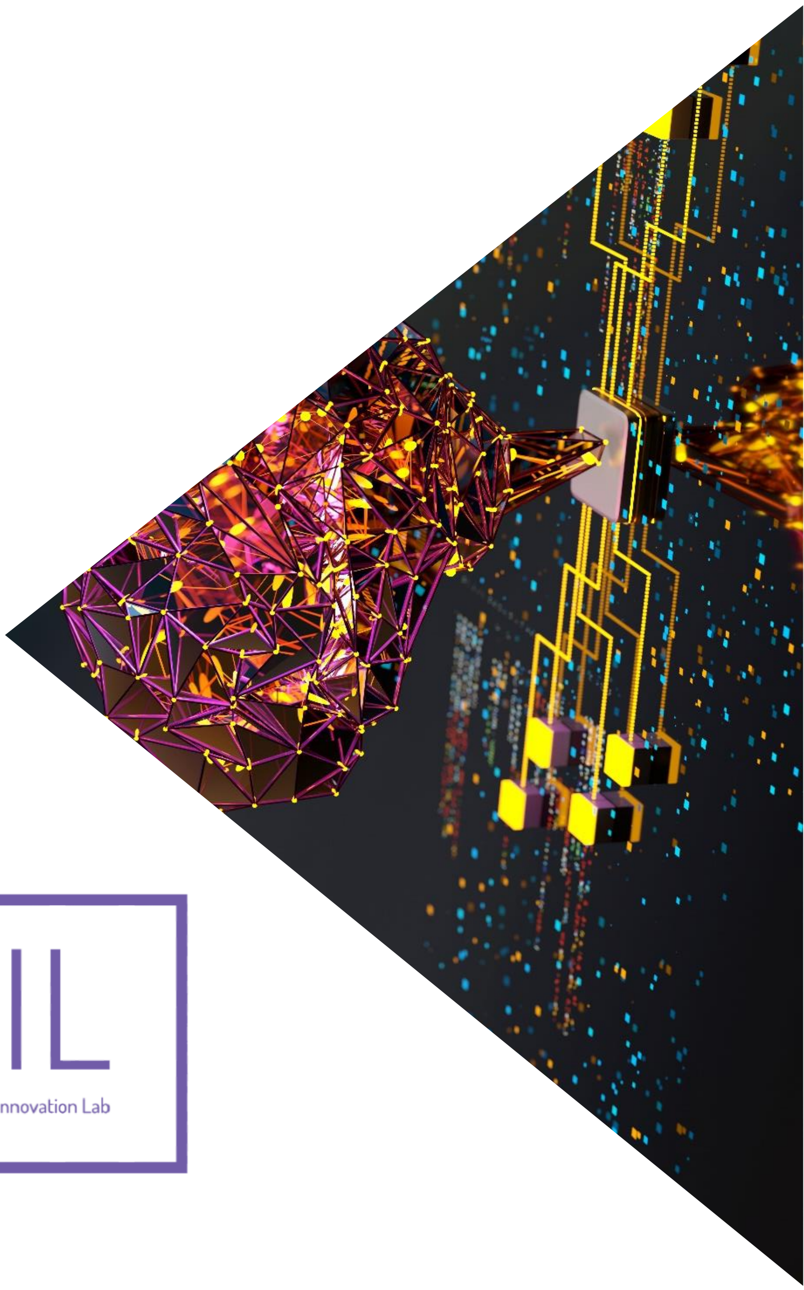

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Generative AI for Simplified ESG Reporting in Financial Services

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29th January 2025

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Generative AI for Simplified ESG Reporting in Financial Services

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Abstract: We demonstrate the potential for Generative AI to simplify Environmental, Social, and Governance (ESG) reporting in financial services. Banking and financial institutions are requiredto comply with ever more stringent and demanding ESG related compliance requirements. A lackof mandatory, universally enforceable sustainable finance standards and guidelines makes effective ESG reporting across industries and countries difficult for financial institutions. Vast amounts of data processing are required, spanning structured quantitative numerical data and unstructured qualitative textual data. Generative AI has the potential to deliver an innovative solution to this ESG reporting challenge through identifiable capabilities in decision support, including document summarisation; data visualisation; individual and multiple company analytics; and customised report generation. Furthermore, several technical features allow organisations to customise Generative AI systems to meet bespoke business requirements and information technology constraints. These technical features include response speed and agility; multiple version choice and algorithmic support; user friendly interfaces; scalability and upgradability. In the use case demonstration, we show how a Large Language Model (LLM) can be used to generate responses to a set of common analyst questions pertaining to ESG using single and multiple annual report sources. This use case brings to life the potential for Generative AI in simplifying compliance in respect of ESG reporting. We then bring together LLM and cutting-edge large Vision Model (LVM) capability to move from text-based prompting to verbal-based prompting for the ESG reporting exercise. We show that this integrated language-vision approach leads to enhancements in performance compared to a sole LLM approach. Indeed, we demonstrate that placing emphasis on key words within the verbal prompts generates more targeted responses from the LLM.

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1. Problem Statement

Banking and financial institutions are required to comply with ever more stringent and demanding environmental, social and governance (ESG) related compliance requirements resulting from the enforcement of various new regulations across many jurisdictions, in particular the UK and the EU. These new regulations require banks and financial services firms to report on an increasing number of metrics pertaining to climate change, environmental damage, biodiversity loss, societal impact, and other factors. This places an obligation on organisations to collect and process an increasing volume of data around its client base (i.e., small, medium and large enterprises), requiring the use of an array of quantitative and qualitative sources. Unstructured text is often used for this purpose, typically via non-financial disclosures released by the companies. This data then needs to be synthesised, analysed and coherently integrated into a host of ESG reporting metrics and submissions to meet ESG compliance requirements.

A lack of mandatory, universally enforceable sustainability reporting standards and guidelines makes effective ESG monitoring across industries and countries difficult for financial institutions. There has been recent progress though through the development of universal frameworks such as the Task Force on Climate-Related Financial Disclosures (TCFD) and the Task Force on Nature-Related Financial Disclosures (TNFD), both created by the Financial Stability Board (FSB). Still, environmental reporting remains largely voluntary in a majority of countries, including in larger economies such as the United States (US). The European Union (EU) and the United Kingdom (UK) are amongst the first movers in enforcing regulations to make disclosure mandatory. For example, the UK Government has enforced mandatory TCFD-aligned disclosure of climate-related risks for large entities in the UK private sector,[1] while the EU has brought into force its European Sustainability Reporting Standards (ESRS) for companies subject to its Corporate Sustainability Reporting Directive (CSRD).[2]

As mandated by the regulations, organisations need to report against key performance indicators (KPIs) as a crucial requirement in ESG reporting. These KPIs determine how ESG-specific insights are required to be generated. For example, the European Commission, in collaboration with the European Federation of Financial Analysis Societies (EFFAS), has previously released ESG KPIs that any company can adopt. Specifically, the European Commission has established a list of KPIs and their corresponding sub-indicators to facilitate reporting across the E, S, and G dimensions (Rapach et al., 2024). This represents a move towards standardisation, yet the differing ways in which this information is disseminated makes it difficult for financial institutions to truly ascertain ESG performance.

Artificial intelligence (AI) offers powerful analytical tools that can process large volumes of data and provide actionable insights. A step change, however, has occurred in the AI landscape in recent times with impressive innovations around AI generated content, with perhaps the most commonly known being Open AI's ChatGPT platform. Generative AI has now become a household concept for the wider public through the ease of access and usability of ChatGPT. Businesses, including banks and financial services firms, are actively assessing

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[1] https://www.gov.uk/government/publications/tcfd-aligned-disclosure-application-guidance/task-force-on-climate-related-financial-disclosure-tcfd-aligned-disclosure-application-guidance.

[2] https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en.

the potential that Generative AI can bring to their organisations, with various business use cases being considered. Deloitte[3] provide a useful summary of use cases in banking and financial services, including code assistance for digital transformation, business intelligence, synthetic data generation, know-your-customer (KYC) report generation, financial advice and support, customised marketing, automated insurance claims reporting, virtual reality-based bank centres, predictive trading algorithms and real-time risk management.

In this report, we focus on demonstrating how Generative AI may provide a solution towards simplifying compliance in respect of the ESG monitoring and reporting challenge outlined above. We do this in two phases that draw on large language model (LLM) and large vision model (LVM) innovations. The first phase focuses on the application of LLM approaches, and the second builds on this through the application of integrated LLM-LVM approaches.

2. Solution Framework

2.1 Generative AI for ESG Reporting

The problem statement articulates the challenge that banking and financial institutions face in respect of compliance to ESG regulations and related ESG reporting requirements. Vast amounts of data processing are required, spanning structured quantitative numerical data and unstructured qualitative textual data. Generative AI has the potential to deliver a paradigm shift in ESG reporting practices within banks and financial services firms.

Lombardi and Secundo (2021) emphasise the need for further investigation into the convergence of digital technology and corporate reporting, encompassing both financial and non-financial aspects, which have traditionally been studied independently. Moodaley and Telukdarie (2023) highlight the scarcity of literature that specifically addresses the interrelationship between non-financial sustainability reporting and artificial intelligence (AI), particularly in the context of greenwashing. Given this existing gap, the potential application of Generative AI as a nascent technology to the challenge of sustainability reporting is an open question. De Villiers et al. (2023) identify the potential for AI generated text capability to impact sustainability reporting within a framework that spans management information, report production, assurance and use. Specifically, de Villiers et al. (2023) cite how Generative AI has the potential to improve the efficiency, accuracy and accessibility of information, reduce the burden of sustainability reporting, enhance the analysis and interpretation of non-financial reporting data, and ultimately increase the accuracy of sustainability reporting. Foehr et al. (2024) propose that LLMs may be used from an auditing perspective to verify and validate sustainability claims. Li et al. (2024) similarly consider the potential of Generative AI to provide ESG assurance, while Wang (2025) explores how Generative AI approaches can be used to identify information delays in ESG ratings. In support of the financial analysis underlying corporate reporting, Kane (2024) provides recommendations on how best to design and engineer prompts to optimise information extraction, which include using defined prompt templates, leveraging prompt chains, incorporating linguistic and cultural context, articulating questions clearly and with specificity, trying different words and phrases, and employing advanced prompt engineering approaches.

In this white paper, we showcase the capability of LLM approaches to extract, summarise and interrogate ESG information in support of ESG reporting requirements. Going beyond LLMs, we integrate both LLM

[3] https://www2.deloitte.com/content/dam/Deloitte/us/Documents/consulting/us-ai-institute-gen-ai-use-cases.pdf.

and cutting-edge LVM capability to enhance this functionality. Before moving to the use case demonstration, we briefly overview the capabilities and risks of Generative AI in the next section.

2.2 Generative AI: Capabilities and Risks

Generative AI offers identifiable benefits from the perspective of ESG reporting, while it simultaneously faces numerous challenges as a nascent technology. The benefits include, but are not limited to:

- **Document Summarisation Capability:** Generative AI systems are ideally designed to generate insightful summaries of key documents that feed into ESG reporting. Careful prompt engineering allows for customised document summaries that meet the requirements of the user. Generative AI systems allow for alternative document summaries to be generated that can alter in terms of focus, format and structure. The capability to map across many documents is also something that Generative AI systems offer.

- **Data Visualisation Capability:** Generative AI systems allow users to easily interrogate and manipulate data to meet ESG reporting requirements. Generative AI can be used to helpfully visualise numerical data, delivering output in common chart formats, while it can equally generate tabularisation of textual data. Hence, it is easy to process and integrate alternative types of quantitative and qualitative data into meaningful visual representations to support ESG assessments. Generative AI systems furthermore allow analysts to more straightforwardly generate such visualisations through conversation-type interactions, removing the need for arduous database negotiation.

- **Individual and Multiple Company Analytics Capability:** Generative AI can be readily used to comprehensively examine individual corporate ESG data over time to discern changes in the ESG characteristics of firms. Identified changes over time can provide important insights into the evolution of a corporate's ESG profile, feeding into the calculation of metrics for ESG reporting purposes. Furthermore, given that banking and financial institutions have exposure to a large portfolio of businesses, Generative AI offers the capability to synthesise ESG data across numerous corporates within the same industry sector or, indeed, across industry sectors. Such use of Generative AI allows for a simplification in preforming comparative analysis across corporates and identifying discrepancies and inconsistencies.

- **Customised Report Generation Capability:** Generative AI can further support the simplification of ESG reporting within banking and financial institutions through leveraging the capabilities to generate content and narrative for reporting purposes. Such content generation can be customised through careful prompt engineering to meet the specific requirements of the user. Through a conversational interaction with the Generative AI system, the user can dictate specific formats and structures to the report content. Furthermore, the user can test alternative approaches to the language, tone and pitch of the report content to ensure that it meets the required standards for the ESG reporting. Indeed, the Generative AI system can be trained on past analyst reports to optimise the similarity of the generated content with the analyst writing and presentation style.

Further to the above data processing and content generation capabilities, there are several technical features to Generative AI systems that are worth highlighting. These include the following:

- **Response Speed and Agility:** Generative AI systems can be tailored to meet response speed and agility preferences of organisations. In this respect, there is a trade-off to be considered depending on available hardware within an organisation. Lower specification Generative AI systems can lead to quicker responses, but performance may be lower. Conversely, higher specification Generative AI systems can deliver higher performance, but responses may be slower. Organisations need to reconcile these competing features based on their available hardware.

• **Multiple Version Choice and Algorithmic Support:** Developments around Generative AI have led to a proliferation of alternative models that offer differing features and capabilities. Indeed, some Generative AI models are designed for application in specific settings, such as FinGPT, which is a large language model trained specifically for finance applications. Developers commonly offer multiple versions of the Generative AI models allowing for bespoke configurations to meet user needs.

• **User Friendly Interface:** Users of Open AI's ChatGPT user interface will be familiar with the ease with which users can interact with the system. In a similar manner, many Generative AI systems can be designed to offer a user-friendly interface to lower frictions in interacting with the system. An organisation can therefore optimise the levels of Generative AI adoption throughout its workforce by ensuring an engaging interface to overlay the system.

• **Scalability and Upgradability:** As Generative AI adoption expands across an organisation, Generative AI systems can be readily scaled to meet the organisation's increasing demands, particularly in terms of functionality and capability. Furthermore, Generative AI systems can be readily upgraded on a periodic basis according to users' evolving requirements. Improvements can be achieved through continual monitoring and training of the Generative AI system.

While the above capability benefits and technical features present significant opportunities for banking and financial institutions in ESG reporting activities, there are notable challenges and risks to Generative AI systems that need to be considered. Specifically, the International Monetary Fund (2023) identify several challenges and risks associated with Generative AI. These include:

• **Data Privacy:** The main concerns in respect of data privacy primarily relate to the use of public Generative AI systems, such as ChatGPT. The concerns centre around the sharingof confidential data and the exposure to external threats. A potential solution to this problem lies in the option to localise Generative AI systems for private usage. This mitigates the above stated risks to some degree, although these cannot be eliminated entirely.

• **Embedded Bias:** The large base of internet sources used to train Generative AI systems means that organisations have limited scope to mitigate embedded bias. This places a bank or financial services firm at considerable risk, particularly from a financial regulation compliance perspective and especially if the Generative AI system is to be used in a customer orientated decision support tool.

• **Robustness:** A recognised issue with Generative AI systems is the potential for hallucinations in the system output. Hallucinations are the generation of false information, largely due to poor quality, limited and incomplete data used in training the system. Banking and financial institutions that deploy Generative AI within their operations need to be confident of the robustness of the system to such hallucination risk.

• **Explainability:** Generative AI models are highly complex, being based on sophisticated deep learning approaches that leverage intricate natural language processing (NLP). These comprehensive systems offer little by way of explainability. While Generative AI offers considerable utility, banks and financial services firms are required to deliver explainability around their AI systems deployment. The requirement for explainability is largely being driven by the changing regulatory landscape in respect of AI and consumer duty.

• **Cybersecurity:** The nascent nature of Generative AI as a technology means that there is limited understanding to date of cybersecurity vulnerabilities. Concern has recently been raised about the threat of adversarial attacks, which involves the manipulation of the input data in order to corrupt the outcomes from Generative AI systems. Moving from a public system to a private system mitigates this risk to some extent. There is also concern about so called "jailbreaking" threats, whereby prompts are designed to break guardrails and access prohibited information in contravention of ethical guidelines.

3. Simplifying ESG Reporting using Large Language Models

With the broad solution framework outlined, we move now to providing a use demonstration of LLM capability for the specific task of supporting ESG reporting. We focus first on information extraction and summarisation.

For our use case analysis, we use Llama 2 from Meta as our underlying LLM.[4] Table 1 provides sample output from the LLM from its analysis of the 2021 annual report for *Barrick Gold Corporation*, a mining company. The LLM was prompted to extract and summarise information that references ESG issues and then provide a table with three columns: the first column provides the relevant page number in the report, the second provides a title for the summary and the third holds the generated summary. The summary extracts can be seen to be targeted and structured for ease of readability, with direct reference back to the annual report where appropriate.

Table 1: LLM-Driven ESG Analysis of Barrick Gold's 2021 Annual Report

PageNo.	**Title**	**LLM Generated Content**
Page44	Respecting human rights and harnessingdiversity	"The challenges of fighting poverty, climate change and biodiversity loss are so deeply connected that we have no option but to tackle all of them, to make lasting progress in any of them." *Grant Beringer, Group Sustainability Executive* (Generated by LLM)

[4] For an overview of Llama 2, please see https://ai.meta.com/blog/5-steps-to-getting-started-with-llama-2/.

<table>
<tr>
<td>Page45</td>
<td>Responsible environmental stewardship</td>
<td>

Building resilience

In the previous section, we discussed how many of our social development efforts are geared to building the resilience of communities to environmental degradation – from agricultural projects that ensure food security to boreholes that bring access to water. At the same time, we recognize that climate change, including shifts in temperature and more extreme weather, is likely to increasingly affect our operations in the years to come, and we are also building the resilience of our company to climate and wider environmental risks. Since 2019, we have worked to disclose against the requirements of the Task Force on Climate-Related Financial Disclosures (TCFD) as part of our annual sustainability reporting.

Climate resilience

Tackling climate change requires global collective action. Our GHG emissions roadmap sets a target to reduce Scope 1 and 2 emissions by at least 30% by 2030 (from a 2018 baseline), while maintaining a steady production profile. Thisis a target grounded in practical measures and does not rely on closing mines, lowering production nor aspirational technology.

FIGURE 4: SNAPSHOT OF ENVIRONMENTAL INDICATORS

<table>
<tr><th></th><th>2021</th><th>2020</th><th>2019</th></tr>
<tr><td>Proportion of sites certified to ISO 14001</td><td>100%</td><td>94%</td><td>76%</td></tr>
<tr><td>Class 1 environmental incidents</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Class 2 environmental incidents</td><td>5</td><td>8</td><td>13</td></tr>
<tr><td>Water use efficiency (reused and recycled)</td><td>82%</td><td>79%</td><td>73%</td></tr>
<tr><td>Total Scope 1 and 2 emissions (kt CO_2e)[1]</td><td>7,105</td><td>7,527</td><td>7,668</td></tr>
<tr><td>Percentage of operational sites with BAPs</td><td>100%</td><td>92%</td><td>54%</td></tr>
</table>

[1] *2020 value restated – see upcoming 2021 Sustainability Report.*

(Generated by LLM)

</td>
</tr>
<tr>
<td>Page57</td>
<td>Climate Change</td>
<td>

The Board's ESG & Nominating Committee is responsible for overseeing

Barrick's policies, programs and performance relating to the environment, including climate change. The Audit & Risk Committee assists the Board in overseeing the Group's management of enterprise risks as well as the implementation of policies and standards for monitoring and mitigating such risks. Climate change is built into our formal risk management process, outputs of which are regularly reviewed by the Audit & Risk Committee. Barrick's climate change strategy has three pillars: (1) identify, understand and mitigate the risks associated with climate change; (2) measure and reduce our impacts on climate change; and (3) improve our disclosure on climate change. Our climate disclosure is based on the recommendations of the Task Force for Climate related Financial Disclosures ("TCFD").

We are also acutely aware of the impacts that climate change has on our host communities and countries, particularly developing nations who are often most vulnerable. As the world economy transitions to renewable power, it is imperative that developing nations are not left behind. As a responsible business, we have focused our efforts on building resilience in our host communities and countries, just as we do for our business.

</td>
</tr>
</table>

		Identify, understand and mitigate the risks associated with climate change We identify and manage risks, build resilience to climate change, as well as position ourselves for new opportunities. Climate change related factors continue to be incorporated into our formal risk assessment process. We have identified several climate-related risks and opportunities for our business including physical impacts of climate change; an increase in regulations that seek to address climate change; and an increase in global investment in innovation and low-carbon technologies. The risk assessment process includesscenario analysis, which is being rolled out to all sites with an initial focus on our Tier One Gold Assets1, to assess site-specific climate related risks and opportunities. **Measure and reduce the Group's impact on climate change** Mining is an energy-intensive business, and we understand the important link between energy use and greenhouse gas ("GHG") emissions. By measuring and effectively managing our energy use, we can reduce our GHG emissions, achieve more efficient production, and reduce our costs. We have climate champions at each site that are tasked with identifying roadmaps and assessing feasibility for our GHG emissions reductions and carbon offsets for hard-to-abate emissions. Any carbon offsets that we pursuemust have appropriate socioeconomic and/or biodiversity benefits. We have published an achievable emissions reduction roadmap and continue to assessfurther reduction opportunities across our operations. **Improve our disclosure on climate change** As part of our commitment to improve our disclosure on climate change, we complete the annual CDP (formerly known as the Carbon Disclosure Project) Climate Change and Water Security questionnaires. This ensures our investor-relevant water use, emissions and climate data are widely available. Our CDP scores were positive and although we maintained our B score for water security, we improved our climate change score a full grade from ac in 2020 to b in 2021. we are also pleased to score as industry leaders for several indicators. for climate change, we scored as industry leaders for governance, emission reduction initiatives, as well as scope 1 & 2 emissions. Similarly, we achieved industry leader scores in water-related opportunities, integrated approach to environmental challenges and business impacts for water security.
Page65	Social license to operate	At Barrick, we are committed to building, operating, and closing our mines in a safe and responsible manner. To do this, we seek to build trust-based partnerships with host governments and local communities to drive shared long-term value while working to minimize the social and environmental impacts of our activities. Geopolitical risks such as resource nationalism and incidents of corruption are inherent in the business of a company operating globally. Past environmental incidents in the extractive industry highlight hazards (e.g., water management, tailings storage facilities, etc.) and the potential consequences to the environment, community health and safety. Our ability to maintain compliance with regulatory and community obligations to protect the environment and our host communities alike remains one of our top priorities. Barrick also recognizes climate change as an area of risk requiring specific focus. **Key risk modification activities:** Our commitment to responsible mining is supported by a robust governanceframework, including an overarching Sustainable Development Policy and related policies in the areas of Biodiversity, Social Performance, Occupational Health and Safety, Environment and Human Rights. Implementation of an ESG scorecard to track our sustainability performance using key performance indicators aligned to priority areas set out in our strategy; QQ Mandatory

		training on our Code of Business Conduct and Ethics as well as supporting policies which set out the ethical behavior expected of everyone working at, or with, Barrick. We take a partnership approach with our host governments. This means we work to balance our own interests and priorities with those of our government partners, working to ensure that everyone derives real value from our operations. We open our social and environmental performance to third party scrutiny, including through the ISO 14001 re-certification process, International CyanideManagement Code audits, and annual human rights impact assessments. Our climate change strategy has three pillars: Identify, understand and mitigate the risks associated with climate change; Measure and reduce ourimpacts on climate change; and improve our disclosure on climate change. We established site-specific emergency response plans as well as regionalcrisis management plans to manage any manifestation of Covid-19 in or nearour mines globally. We continuously review and update our closure plans and cost estimates toplan for environmentally responsible closure and monitoring of operations.

3.1 ESG Interrogation (Single Annual Report Analysis)

In this section, we build on the previous use case and demonstrate how an LLM can be used to provide more analytical insights into corporate ESG credentials. Based on more than a decade serving in corporate board rooms, Moyo (2022) outlines ten questions every company should address as they embed an ESG strategy. Table 2 summarises these questions. Feeding these ESG questions into Llama 2 as prompts, Table 3 provides a view of Barrick Gold Corporation's approach to each question. Using this technique, we can interrogate a firm's commitment to sustainable and responsible business practices. We again use the 2021 Annual Report from Barrick Gold Corporation when prompting with these questions.

Table 2: Top 10 ESG Questions (Moyo, 2022)

	Question	Explanation
1	Is ESG undermining your company's competitiveness?	Concerns about whether a strong focus on ESG objectives might detract from a company's growth, market share, and profits.
2	Does driving the ESG agenda meansacrificing company returns?	The potential risk of ESG focus being viewed as harmful to financial shareholder returns, despite evidence of high returns from ESG investments.
3	How are you navigating ESG trade-offs?	Dealing with the complex trade-offs in the shift towards broader stakeholder capitalism, including various ESG aspects.
4	How does ESG change due diligence?	The need for ESG audits in evaluating a company's assets, such as in M&A transactions and capital raising.
5	Should you become a public benefit corporation?	Considering the shift to a public benefit corporation or B-corps structure to prioritize environmental and social stakeholders.

6	How should corporations address societal concerns such as racial equity?	Ensuring a transparent and consistent framework in addressing racial justice and other societal concerns.
7	How do you develop a global approach to ESG?	Incorporating different countries and cultures into a comprehensive ESG approach.
8	How do you build an ESG framework that is future proofed for tomorrow's economic realities?	Designing an ESG system that is adaptable to future economic structures.
9	How do you vet company performance of ESG?	Determining how to vet ESG results for compliance, including the role of independent auditors and regulatory bodies.
10	How should corporations navigate the ever-changing landscape of ESG?	Developing metrics to track ESG progress and anticipating evolving regulatory standards.

Table 3: Barrick Gold Corporation's ESG Strategy: Key Questions and LLM Responses (Single Report Analysis)

	Question	LLM Generated Response
1	Is ESG undermining your company's competitiveness?	For Barrick Gold Corporation, ESG is seen as an integral part of its business strategy, enhancing rather than undermining competitiveness. The company's focus on the social aspect of ESG, especially in less-developed host countries, suggests that it views ESG to strengthen its market position and align with broader societal goals.
2	Does driving the ESG agenda mean sacrificing company returns?	Barrick's report does not directly address the impact of ESG on company returns, but the company's commitment to ESG suggests a belief in the compatibility of sustainable practices with financial performance. Barrick appears to recognize that responsible operations can contribute to long-term profitability and stakeholder trust.
3	How are you navigating ESG trade-offs?	Barrick navigates ESG trade-offs by integrating sustainability into its business model. The company's focus on human rights, health, safety, and environmental management indicates an approach where ESG is seen not as a trade-off but as an essential component of its overall business strategy.
4	How does ESG change due diligence?	Barrick's approach to due diligence includes significant ESG considerations, as seen in the role of its Environmental Social Governance & Nominating Committee. This indicates that the company views ESG factors as critical in evaluating its operations and aligning with sustainable practices.
5	Should you become a public benefit corporation?	While Barrick's report does not explicitly discuss becoming a public benefit corporation, the company's practices suggest acommitment to balancing financial objectives with environmentaland social responsibilities, aligning with the ethos of a public benefit corporation.

6	How should corporations address societal concerns such as racial equity?	Barrick addresses societal concerns, including racial equity, through inclusive employment practices. The high percentage of host country nationals in its workforce and management indicates a commitment to diversity and cultural alignment, suggesting a proactive approach to societal concerns.
7	How do you develop a global approach to ESG?	Barrick develops a global ESG approach by acknowledging the importance of cultural and operational diversity. The company's adaptation of its ESG strategies to different geographies and cultures demonstrates a comprehensive and flexible approach to ESG.
8	How do you build an ESG framework that is future proofedfor tomorrow's economic realities?	Barrick's Sustainability Scorecard, which benchmarks ESG performance against peers and past performance, illustrates a future-focused approach. This strategy indicates Barrick's commitment to evolving its ESG practices in line with changing economic realities and stakeholder expectations.
9	How do you vet companyperformance of ESG?	Barrick vets its ESG performance using independent sustainability experts and key performance indicators aligned with sustainable mining principles. This robust vetting process reflects a commitment to transparency, accountability, and adherence to high ESG standards.
10	How should corporationsnavigate the ever-changinglandscape of ESG?	Barrick navigates the evolving ESG landscape by continuously tracking progress against its Sustainability Scorecard, adapting to changes, and maintaining stakeholder partnerships. This approach demonstrates a commitment to staying ahead in ESG practices and aligning with regulatory standards.

This use case demonstrates how Generative AI allows an analyst to efficiently assess Barrick Gold Corporation's commitment to its ESG objectives. Broadly, Generative AI offers the potential for sophisticated data analysis, predictive insights, and real-time monitoring capabilities. These tools have the potential to assist banking and financial services professionals in assessing corporate alignment to institutional sustainability priorities and regulatory compliance requirements. Note that the LLM generated content in this use case demonstration is necessarily brief to conserve on space. However, more extensive text generation and analysis is possible with a combination of increased computational power and more sophisticated LLMs. We deploy more advanced LLM capability in the forthcoming sections.

3.2 ESG Interrogation (Multiple Annual Report Analysis)

We repeat the ESG interrogation exercise but, in this section, configure the LLM to support multiple file inputs, basing our analysis on the annual reports of Barrick Gold Corporation over the period between 2019 and 2021. This allows for a temporal analysis of changes over time. Furthermore, for this analysis, we use Llama 3 as a more sophisticated localised LLM. Table 4 provides a summary of Barrick Gold Corporation's approach to each of the above referenced ESG questions (Table 2), this time drawing on the information aggregated over the period between 2019 and 2021. Relative to the previous section, more extensive responses to the questions are generated, although much more detail and analysis can be requested at the user's discretion.

It is interesting to note that the LLM generates responses that are inclined to display changes in key corporate information over the period in question. This may suggest a reasoning on the part of the LLM that the user may wish to judge the *relative changes* in these key measures rather than the *raw levels*.

Table 4: Barrick Gold Corporation's ESG Strategy: Key Questions and LLM Responses (Multiple Report Analysis)

	Question	LLM Response
1	Is ESG undermining your company's competitiveness?	No, ESG is not undermining Barrick's competitiveness; it enhances it. Barrick's long-term competitiveness is demonstrated by its continued financial success while maintaining a strong ESG focus. For instance, in 2020, Barrick reported a 197% increase in free cash flow, reaching $3.4 billion, compared to the previous year (Annual Report 2020). This shows that integrating ESG into operations not only enhances trust with local communities and governments but also supports financial performance. Barrick's technological innovations, such as data-driven decision-making tools, have further reduced environmental impacts and operational costs, contributing to its competitive edge (Annual Report 2020).
2	Does driving the ESG agenda mean sacrificing company returns?	No. Barrick's data shows that driving the ESG agenda has not led to sacrificing returns. In fact, from 2019 to 2020, Barrick's dividend per share increased by 65%, reflecting growing returns to shareholders (Annual Report 2020, 2021). Moreover, the company achieved a 91% increase in operating cash flow, from $2.8 billion in 2019 to $5.4 billion in 2020 (Annual Report 2020). This data underscores how ESG and financial performance can go hand in hand, with ESG initiatives supporting long-term sustainable profitability rather than undermining it.
3	How are you navigating ESG trade-offs?	Barrick navigates ESG trade-offs by integrating ESG into its decision-making processes, balancing financial, environmental, and social factors. The company's $1.9 billion in free cash flow in 2021 (Annual Report 2021) demonstrates that prioritizing ESG does not come at the expense of profitability. Barrick's success in addressing trade-offs can be seen in its renewable energy investments, such as the Loulo-Gounkoto solar power project, which contributes to reducing operational emissions while maintaining cost efficiency (Annual Report 2020, 2021).
4	How does ESG change due diligence?	ESG considerations have fundamentally changed how Barrick conducts due diligence. This is reflected in the company's sustainability-focused projects and capital allocation. For instance, in 2020, Barrick's Pueblo Viejo mine received Environmental Impact Assessment approval for a plant expansion that will increase throughput by 50%, showing how ESG factors are fully integrated into project assessments (Annual Report 2020). Additionally, in 2021, 100% of Barrick's operational sites were certified under ISO

		14001 and ISO 45001, demonstrating its commitment to environmental and safety standards in due diligence processes
5	Should you become a public benefit corporation?	Although Barrick is not legally structured as a public benefit corporation (PBC), its ESG data reflects a commitment to broader societal goals. For example, the company's partnership with Tanzania, Twiga Minerals, resulted in a $250 million dividend to the Tanzanian government, ensuring that local communities benefit from mining operations (Annual Report 2020). Barrick's actions, such as resolving long-standing disputes with Tanzania and delivering tangible benefits to host nations, illustrate that the company aligns with the principles of a PBC, prioritizing not just shareholder value but broader stakeholder interests.
6	How should corporations address societal concerns such as racial equity?	Barrick is committed to addressing societal concerns, including racial equity, by promoting diversity and local employment. In its African operations, 95% of the workforce is drawn from host nations (Annual Report 2020). Additionally, Barrick has developed training programs to upskill local employees, ensuring they can achieve international standards in management and operations. These initiatives reflect Barrick's commitment to supporting racial equity and local economic development, as seen in its increase in local hires and long-term employment strategies across its global operations (Annual Report 2020, 2021).
7	How do you develop a global approach to ESG?	Barrick's global approach to ESG is built on both global standards and local adaptations. In 2020, Barrick reduced its greenhouse gas emissions by 13% compared to 2019 and has set a goal to achieve net-zero emissions by 2050 (Annual Report 2020, 2021). The company also integrates local concerns into its ESG framework; for instance, in Latin America, Barrick reduced water usage by 18% in its mining operations through water recycling initiatives (Annual Report 2020). This demonstrates how Barrick tailors its ESG strategy to meet both global and regional needs.
8	How do you build an ESG framework that is future proofed for tomorrow's economic realities?	Barrick ensures that its ESG framework is future proof by continuously investing in technology and innovation. In 2021, the company's renewable energy initiatives in the Loulo-Gounkoto complex in Mali helped reduce carbon emissions by 20% (Annual Report 2020, 2021). Barrick's commitment to sustainable energy solutions, such as implementing new battery technologies at the Kibali mine to reduce reliance on diesel, is another example of how it future-proofs its operations against economic and environmental challenges (Annual Report 2020).
9	How do you vet company performance of ESG?	Barrick rigorously monitors its ESG performance using detailed reporting and external validation. In 2021, Barrick maintained its listing on the prestigious Dow Jones Sustainability Index for the 13th consecutive year, highlighting its consistent commitment to sustainability (Annual Report 2020, 2021). Additionally, the company achieved zero Class 1 environmental incidents in 2020, showcasing the effectiveness of its environmental risk management systems (Annual Report 2020). These metrics provide a clear framework for assessing the company's ESG performance and ensuring accountability.

10	How should corporations navigate the ever-changing landscape of ESG?	Barrick navigates the changing ESG landscape by maintaining flexibility and forward-thinking strategies. The company's ISO 14001 and ISO 45001 certification of 100% of its sites in 2021 shows its proactive approach to adapting to new ESG standards (Annual Report 2021). Barrick's increased engagement with clean energy solutions, such as its solar projects and gas-powered initiatives, reflects how the company anticipates and responds to the evolving regulatory and environmental landscape (Annual Report 2020, 2021).

4. Simplifying ESG Reporting through an Integration of Large Language Models and Large Vision Models

In this section, we extend the analysis thus far by overlaying a Large Vision Model (LVM) interface to facilitate the LLM prompting. This replaces the need for text-based prompts, instead allowing the user to appear on camera and speak the prompts. We repeat the ESG interrogation analysis of the previous section, providing again an overview of Barrick Gold Corporation's approach to each of the above referenced ESG questions (Table 2). Responses were generated through an integrated LLM-LVM approach on this occasion, with the LVM not only "seeing" and "reading" the environment and the expressions from the human being but also "reasoning" about actions based on both visual and textual data.

While a technical description of LVMs is out of scope for this white paper, we would direct the interested reader to the study of Carolan et al. (2024). For our implementation, we aim to develop a local LVM that integrates with local LLMs, leveraging a device's camera and microphone and enabling real-time processing of both speech and visual inputs. When a user talks to the LVM, the system uses automatic speech recognition to convert speech into text and analyses it with an LLM. At the same time, it detects changes in pitch and emphasis. Based on these inputs, the system adjusts its response dynamically, offering more detailed explanations for the emphasised parts, making interactions feel more natural. Finally, the system converts the LLM responses back into speech, completing the human-AI conversation workflow.

From a technical perspective, the system is built using a Python-based technology stack. It employs *Whisper*[5] for speech recognition, the *Transformers* library for LVM processing, *OpenCV*[6] for real-time camera input analysis, *SoundDevice*[7] for low-latency audio recording, and *pyttsx3*[8] for offline text-to-speech conversion, ensuring that all processing is conducted locally for improved data security. A key interactive feature of this system is its ability to analyse emotions and accents in speech. Specifically, we use

[5] Whisper is an open-source automatic speech recognition (ASR) model, it can accurately transcribe and translate spoken language across multiple languages, even in noisy environments, using deep learning.
[6] OpenCV (Open-Source Computer Vision Library) is an open-source machine learning package that provides a wide range of tools for real-time image and video processing, including object detection, face recognition, and camera-based applications.
[7] SoundDevice is a Python package that provides interface for recording and playing audio with low latency
[8] pyttsx3 is a Python text-to-speech (TTS) package that allows offline speech synthesis, enabling applications to convert text into spoken words without requiring an internet connection.

Librosa[9] to track pitch variations and *NumPy*[10] to extract volume levels, encoding these as input conditions for the LVM. This allows the model to adapt dynamically based on the user's speech patterns. Additionally, the system processes visual input using *TorchVision*[11], which converts RGB images for the visual encoder, ensuring real-time multimodal interaction. All components, including *Whisper* and the LVM, are optimized using *PyTorch*[12] runtime enhancements for efficient execution on local devices.

In summary, we aim to integrate a multimodal AI system that understands speech emphasis, rhythm, and emotions, while integrating visual context to generate smarter, more natural responses. By running entirely on local hardware, the system ensures data privacy and security.

Leveraging the above capability, Table 5 is based on a dialogue between the lead author (Hao Zhang) and the LVM, in which the lead author manually read each question aloud to the LVM through a microphone and in front of a camera, such that the model captures facial and vocal features and uses the stress and expression of pronunciation to guide the LLM-LVM-generated response. While Table 4 (Section 3.2) and Table 5 both report results based on Llama 3 as the underlying LLM, the latter use of the integrated LVM-LLM approach leads to qualitatively similar but notably more extensive responses. This points to the potential for the use of integrated LLM-LVM approaches to better support ESG compliance and reporting objectives. Furthermore, the ability to verbally communicate and interact with the underlying LLM presents considerable speed enhancements and process efficiencies for compliance professionals.

Table 5: Barrick Gold Corporation's ESG Strategy: Key Questions and Responses Generated by Integrated LLM-LVM Analysis

	Question	LVM Response
1	Is ESG undermining your company' s competitiveness?	No. Barrick Gold Corporation demonstrates that ESG strengthens its competitiveness through various strategies and practices: 1. Integration of ESG into Core Business Strategy: Barrick integrates sustainability into its DNA, ensuring that sustainability-related risks and opportunities are managed at the operational level rather than just as a compliance exercise. Sites are empowered to align ESG practices with business goals, creating value for stakeholders and the business. (Annual Report 2020) 2. ESG Governance Enhancements: The Environmental and Social Oversight Committee (E&S Committee) and the sustainability scorecard are key elements of ESG governance. They connect site-level responsibility with strategic oversight and align operations with the

[9] Librosa is a Python package for audio analysis, providing tools for loading, processing, and extracting features from sound signals.

[10] NumPy (Numerical Python) is a Python package for numerical computing, providing support for multi-dimensional arrays, mathematical functions, and efficient numerical operations

[11] TorchVision is a package within the PyTorch ecosystem, providing pre-trained models, image transformations, and dataset utilities to facilitate tasks such as image classification, object detection

[12] PyTorch is an open-source deep learning framework, designed for tensor computation, automatic differentiation, and neural network training,

		company's vision, improving efficiency and competitiveness. 3. Measurable Improvements and Targets: Barrick introduced an ESG scorecard to measure progress in sustainability practices and benchmark against industry standards. For instance, Barrick achieved significant improvements, including the reduction of fuel usage at Kibali mine and enhanced water management in Tanzania, underscoring how ESG initiatives enhance operational efficiency. (Annual Report 2018 and 2021) 4. Financial Impact of ESG Practices: By focusing on disciplined growth, strong governance, and resource efficiency, Barrick increased free cash flow significantly in 2020, demonstrating that ESG practices contribute to financial health. (Annual Report 2019 and 2020) 5. Innovation and Resilience: ESG-driven innovation includes deploying clean energy solutions like solar power plants, reducing greenhouse gas emissions, and using technology for safety and resource optimization. These initiatives align with global environmental standards and position Barrick as a competitive, sustainable mining company. (Annual Report 2020 and 2021) 6. Building Trust and Partnerships: ESG practices foster trust with stakeholders, governments, and communities. These partnerships provide Barrick with a robust social license to operate, a crucial competitive advantage in the global mining industry. Barrick's proactive approach to ESG indicates that it is a driver of value and competitiveness rather than a detractor.
2	Does driving the ESG agenda mean sacrificing company returns?	No, Barrick Gold Corporation demonstrates that driving the ESG agenda aligns with enhancing company returns, not sacrificing them: Operational Efficiency Gains: ESG initiatives such as reducing environmental impact and improving resource efficiency directly contribute to cost savings. For example, the introduction of battery technology at Kibali mine saved over 1.6 million liters of fuel during the DRC's dry season. Increased Cash Flow: In 2020, Barrick reported record free cash flow of $3,363 million, driven in part by disciplined ESG integration into operations. Enhanced Shareholder Returns: The company tripled dividends per share since the Randgold merger and returned $2.5 billion to shareholders, demonstrating that ESG investments support profitability and shareholder value. ESG as a Value Driver: ESG efforts attract sustainability-focused investors. Barrick maintained its position in the Dow Jones Sustainability Index, reinforcing trust and long-term value generation. Long-Term Strategy Alignment: The implementation of renewable energy projects and sustainable water management systems not only reduce environmental risks but also contribute to cost stability and operational resilience.

		Barrick’s integration of ESG into its business strategy is a catalyst for growth, aligning sustainability with financial performance.
3	How are you navigating ESG trade-offs?	Barrick Gold Corporation navigates ESG trade-offs through a combination of strong governance, site-specific decision-making, and stakeholder engagement. The Environmental and Social Oversight Committee (E&S Committee) ensures alignment between site-level practices and corporate goals, fostering localized decision-making that addresses sustainability priorities without compromising operational efficiency. For example, the committee regularly reviews emerging challenges and sustainability metrics, enabling flexible responses tailored to specific site needs. This bottom-up governance model empowers individual sites to adapt to regional challenges, demonstrating a practical approach to managing ESG trade-offs effectively. In addition to governance, Barrick incorporates innovative solutions to minimize conflicts between operational goals and environmental or social impacts. For example, the use of battery technology at the Kibali mine significantly reduced fuel consumption during the dry season, showcasing how operational efficiency can align with sustainability objectives. Moreover, the establishment of Community Development Committees ensures that local stakeholder concerns are addressed alongside business needs. These initiatives reflect Barrick’s commitment to balancing ESG trade-offs through innovative practices and community-centred solution.
4	How does ESG change due diligence?	Barrick Gold Corporation effectively navigates ESG trade-offs by combining strong governance, site-level accountability, and transparent reporting mechanisms. The company integrates ESG considerations into decision-making processes at all levels, ensuring that sustainability efforts align with operational goals while addressing environmental, social, and economic priorities. Strong Governance Structure: Barrick’s Environmental and Social Oversight Committee (E&S Committee) oversees site-level sustainability practices, ensuring alignment with group-wide goals. The committee regularly reviews key performance indicators, enabling data-driven decisions that balance competing ESG priorities. (Annual Report 2020) Tailored Site-Level Initiatives: Empowering local mines to make decisions enables site-specific solutions to ESG trade-offs. For example, in Tanzania, Barrick resolved stakeholder concerns by establishing a Community Development Committee (CDC) and investing $65 million in water management initiatives. (Annual Report 2019,2020) Transparent Monitoring: The introduction of Barrick's Sustainability Scorecard in 2019 ensures that ESG metrics are monitored and benchmarked against peers. This transparent tracking helps identify opportunities and challenges, guiding balanced decision-making. (Annual Report 2020, 2021) Strategic Adaptation: Barrick’s governance framework adapts to new challenges, such as the development of a climate strategy focused on mitigating risks, reducing impacts, and improving climate-related disclosures. This adaptability ensures long-term sustainability without

		compromising business performance. (Annual Report 2020, 2021)
5	Should you become a public benefit corporation?	Barrick Gold Corporation aligns with many principles of a public benefit corporation (PBC) but does not require a formal transition to this status. Barrick already integrates stakeholder value creation and sustainability into its operational and governance frameworks, fulfilling many PBC objectives without the legal designation. Governance and Oversight: Barrick's Environmental and Social Oversight Committee ensures that sustainability initiatives align with strategic goals, demonstrating a commitment to long-term environmental and social objectives. (Annual Report 2019,2020) Stakeholder Value Creation: The company invests significantly in community development projects. Financial and Social Responsibility: Barrick combines strong financial performance with its ESG commitments. In 2021, it achieved a B-grade on its Sustainability Scorecard, reflecting consistent performance across key ESG metrics, including environmental and social initiatives. (Annual Report 2020) Global ESG Leadership: Barrick has been recognized for its sustainability efforts, including 14 years of inclusion in the Dow Jones Sustainability Index, ranking in the 95th percentile of mining companies. This demonstrates its ability to lead in sustainability while delivering value to shareholders. (Annual Report 2020)
6	How should corporations address societal concerns such as racial equity?	Barrick Gold Corporation addresses societal concerns, including racial equity, by fostering an inclusive culture, implementing robust human rights programs, and actively supporting local communities. These initiatives align with Barrick's commitment to sustainability and reflect his dedication to diversity, equity, and inclusion. Human Rights Program: Barrick implements its Human Rights Program through monitoring, reporting, and conducting due diligence across all operational sites. The program also includes mandatory training for employees on human rights and additional specialized training for security personnel. (Annual Report 2021) Diversity and Inclusion: Barrick fosters a supportive working environment, ensuring that individuals are hired based on merit, irrespective of race, gender, disability, or other factors. (Annual Report 2021) Community Engagement: Through its Community Development Committees, Barrick empowers local stakeholders to guide investment in projects that address societal needs. (Annual Report 2021) Governance and Policy Frameworks: Barrick's Human Rights Policy aligns with international guidelines such as the UN Guiding Principles on Business and Human Rights and the OECD Guidelines for Multinational Enterprises, emphasizing zero tolerance for human rights violations and a commitment to recognizing the rights of Indigenous Peoples. (Annual Report 2021)
7	How do you develop a global approach to ESG?	Barrick Gold Corporation develops a global approach to ESG by integrating sustainability into its core operations through governance structures, local accountability, and innovation. This strategy ensures alignment with international standards while addressing site-specific

		needs and challenges. Governance Framework: Barrick’s sustainability strategy is built on four pillars: respecting human rights, protecting health and safety, sharing operational benefits, and managing environmental impacts. The Environmental and Social Oversight Committee (E&S Committee) connects site-level ownership of sustainability with corporate governance, ensuring consistent alignment across all operations. (Annual Report 2021) Site-Specific Responsibility: The company employs a decentralized governance model where each site is empowered to manage its sustainability performance. This includes setting specific goals and monitoring progress in areas such as climate resilience, biodiversity conservation, and water management. (Annual Report 2020) Sustainability Scorecard: Introduced in 2019, the Sustainability Scorecard measures ESG performance across sites and tracks progress against global benchmarks. It includes metrics aligned with frameworks like the UN Global Compact and the Responsible Gold Mining Principles (RGMPs), promoting transparency and accountability. (Annual Report 2019, 2021) Climate Action and Innovation: Barrick has implemented a roadmap to reduce greenhouse gas emissions by 30% by 2030 (from a 2018 baseline) while maintaining operational efficiency. This includes renewable energy projects like the Nevada 200MW solar farm and hydropower initiatives in Africa. (Annual Report 2018)
8	How do you build an ESG framework that is future proofed for tomorrow’s economic realities?	Barrick Gold Corporation builds a future-proof ESG framework by combining governance, local empowerment, and transparent monitoring with strategic adaptation to global sustainability trends. This approach ensures resilience in a dynamic economic environment while fostering sustainable growth and stakeholder trust. Governance and Integration: The Environmental and Social Oversight Committee (E&S Committee) ensures that sustainability is embedded in decision-making at both site and executive levels. The committee reviews ESG performance quarterly, driving alignment with global priorities and facilitating timely responses to emerging challenges. (Annual Report 2020, 2021) Local Accountability and Adaptation: Barrick employs a bottom-up governance structure, where individual sites are empowered to tailor sustainability efforts to their unique contexts. (Annual Report 2021) Innovation and Transparency: The Sustainability Scorecard, introduced in 2019, provides a framework for tracking key performance indicators aligned with global benchmarks such as the United Nations Global Compact and the World Gold Council's Responsible Gold Mining Principles. This transparency enhances internal accountability and external stakeholder trust. (Annual Report 2019, 2021) Strategic Climate Action: Barrick has implemented a clear roadmap to reduce greenhouse gas emissions by 30% by 2030 (from a 2018 baseline). Projects like the 200MW solar plant in Nevada demonstrate how the company aligns climate resilience with operational efficiency. (Annual Report 2018, 2020, 2021)

9	How do you vet company performance of ESG?	Barrick Gold Corporation vets ESG performance through structured governance, transparent reporting mechanisms, and independent benchmarking. These practices ensure accountability and continuous improvement across its operations. Governance and Oversight: The Environmental and Social Oversight Committee (E&S Committee) reviews ESG performance quarterly, ensuring alignment with corporate goals and strategic priorities. Reports are reviewed by the ESG & Nominating Committee to maintain adherence to sustainability policies. (Annual Report 2020) Sustainability Scorecard: Introduced in 2019, Barrick's Sustainability Scorecard evaluates performance across key ESG metrics such as health and safety, environmental management, and community impact. This scorecard is a cornerstone of its performance evaluation framework. (Annual Report 2019) Independent Benchmarking: Barrick has been included in the Dow Jones Sustainability Index (DJSI) for 14 consecutive years, ranking in the 95th percentile among mining companies. This independent validation underscores the company's commitment to meeting global ESG standards. (Annual Report 2020, 2021) Self-Assessments and Compliance: Each mine conducts self-assessments against the Responsible Gold Mining Principles (RGMPs) and creates action plans to address identified gaps, ensuring consistent alignment with international ESG benchmarks. (Annual Report 2021)
10	How should corporations navigate the ever-changing landscape of ESG?	Corporations like Barrick Gold Corporation navigate the dynamic ESG landscape by leveraging strong governance, fostering innovation, and maintaining flexibility to adapt to evolving priorities. These strategies ensure alignment with global standards while addressing local and global challenges. Robust Governance Structure: Barrick’s Environmental and Social Oversight Committee (E&S Committee) provides quarterly oversight to ensure ESG priorities are integrated across operations and aligned with corporate goals. This governance model enables proactive adaptation to changing regulatory and stakeholder expectations. Sustainability Metrics and Tracking: The Sustainability Scorecard, introduced in 2019, benchmarks performance across key ESG metrics, guiding the company’s strategy and enabling accountability. Innovation and Climate Action: Barrick’s commitment to climate action includes a roadmap to reduce greenhouse gas emissions by 30% by 2030, with initiatives like the Nevada solar plant contributing to this goal. Innovation in energy efficiency and renewable energy adoption helps the company stay ahead of environmental demands. Stakeholder Engagement and Local Empowerment: The company actively engages local stakeholders through Community Development Committees and invests in regional needs. Global Benchmarking and Recognition: Barrick’s inclusion in the Dow Jones Sustainability Index (DJSI) for 14 consecutive years reflects its ability to align with global ESG standards while adapting to evolving trends and expectations.

We now repeat the analysis above but on this occasion we deliberately emphasise selected keywords when asking the same ESG related questions. Table 6 presents these results, with the keywords emphasised as part of the exercise highlighted in **bold text**. When emphasis is placed on certain keywords, the LVM weights the text according to the tone of voice, leading the LLM response to concentrate on the emphasised words in the verbal prompt. Comparing Table 5 and Table 6 shows qualitatively similar responses. However, the use of emphasis in the prompting appears to focus the LLM to deliver more tailored responses that are more expansive in terms of detail. This qualitative observation is highly interesting and warrants more rigorous quantitative comparison of LLM responses as generated from alternative LLM and LLM-LVM implementations. We defer this for future work.

Table 6: Barrick Gold Corporation's ESG Strategy: Key Questions and Responses Generated by Integrated LLM-LVM Analysis with Deliberate Word Emphasis

	Queston	**LVM Response**
1	Is ESG **undermining** your company' s **competitiveness**?	No, ESG initiatives at Barrick Gold Corporation enhance rather than undermine competitiveness. By integrating sustainability into its operations, Barrick leverages governance, innovation, and stakeholder engagement to reduce risks and identify opportunities. In 2020, the company introduced an internal ESG handbook to embed sustainability considerations into its business philosophy, ensuring ESG efforts are part of decision-making processes at all operational levels. ESG-driven innovations have significantly improved operational efficiency. For example, the introduction of battery technology at the Kibali mine in the Democratic Republic of Congo saved 1.6 million liters of fuel within six months during the dry season. Additionally, the Total Reportable Injury Frequency Rate (TRIFR) in the Latin America and Asia Pacific regions was halved in 2020, demonstrating how ESG initiatives align with and enhance operational goals. Financially, Barrick's ESG integration has proven successful, with the company generating \$3.36 billion in free cash flow in 2020, a substantial increase from \$1.13 billion in 2019. Global recognition further underscores Barrick's ESG leadership. The company has been included in the Dow Jones Sustainability Index (DJSI) for 14 consecutive years, ranking in the 95th percentile of mining companies in 2020. This consistent recognition highlights Barrick's ability to combine strong ESG performance with industry leadership, reinforcing that its sustainability efforts are not just complementary but central to its competitiveness and long-term success.
2	Does **driving** the ESG agenda mean **sacrificing company returns**?	No, driving the ESG agenda does not mean sacrificing company returns for Barrick Gold Corporation. On the contrary, the integration of ESG initiatives has enhanced operational efficiency and contributed to significant financial growth. For example, ESG-driven innovation at the Kibali mine in the Democratic Republic of Congo led to the implementation

		of battery technology, saving over 1.6 million liters of fuel within six months during the dry season. Such initiatives demonstrate how sustainability practices align with and improve operational goals. Financially, Barrick’s commitment to ESG has translated into measurable success. The company’s free cash flow grew from $1.13 billion in 2019 to $3.36 billion in 2020, driven by disciplined operational strategies and the integration of sustainability efforts. At the same time, Barrick has actively supported host communities, investing $26.5 million in 2021 in projects like clean water initiatives and education programs. These investments not only enhance the quality of life for local stakeholders but also strengthen the company’s social license to operate. Barrick’s leadership in ESG is further recognized through its consistent inclusion in the Dow Jones Sustainability Index (DJSI) for 14 consecutive years, ranking in the 95th percentile among mining companies in 2021. This recognition highlights how ESG integration bolsters corporate reputation and attracts sustainability-focused investors. Collectively, these examples demonstrate that ESG initiatives are not a financial trade-off but a strategic driver of growth, operational excellence, and stakeholder trust.
3	How are you **navigating** ESG trade-offs?	Barrick Gold Corporation integrates ESG into core operations by embedding sustainability into decision-making processes at every site, enabling locally tailored solutions to trade-offs, such as water management in arid regions. Governance oversight is provided by the Environmental and Social Oversight Committee, ensuring that environmental, social, and operational priorities are effectively balanced. Leveraging innovations like solar energy installations and water recycling systems—achieving 82% water reuse in 2021—allows Barrick to minimize environmental impacts while maintaining efficiency. Building local partnerships through Community Development Committees aligns operational goals with community needs, delivering social benefits. Transparency is maintained through the Sustainability Scorecard, which evaluates the impact of trade-offs on ESG objectives and ensures alignment with global standards. Additionally, Barrick’s commitment to addressing climate change, including its goal to reduce greenhouse gas emissions by 30% by 2030, highlights its proactive approach to balancing emissions with sustainability objectives.
4	How does ESG **change** due diligence?	ESG has become a core component of due diligence at Barrick. When evaluating new projects, the company not only assesses financial and technical feasibility but also examines social licenses to operate, environmental impacts, and governance compliance. For example, during feasibility studies for new mines, Barrick evaluates environmental sensitivity, adherence to international mining standards, and community acceptance. This multidimensional due diligence helps ensure that Barrick’s operations do not harm the environment or trigger social conflicts, thereby reducing potential legal and operational risks ESG has fundamentally reshaped Barrick Gold Corporation's due diligence processes by embedding sustainability and human rights considerations at all levels. ESG assessments, including human rights evaluations, are conducted at all operational sites on a two- or three-year cycle, with medium and high-risk sites undergoing independent reviews, such as those completed at Kibali and Loulo-Gounko to in 2021. The implementation of a refreshed Human Rights Program in 2020 enhanced

		monitoring and training efforts, including specialized courses for security personnel. ESG data is now integral to investment decisions, with metrics like the Lost Time Injury Frequency Rate (LTIFR) improving from 0.50 in 2019 to 0.34 in 2020, reflecting strengthened safety measures. Governance oversight by the Environmental and Social Oversight Committee ensures that sustainability considerations are integrated into site-level operations and executive leadership strategies, enhancing both decision-making and stakeholder trust.
5	Should you become a **public benefit** corporation?	While Barrick Gold Corporation aligns with many principles of a public benefit corporation (PBC), transitioning to a formal PBC status may not provide additional strategic benefits given its current governance and operational framework. Barrick already integrates stakeholder value creation and sustainability into its operations, effectively fulfilling many PBC objectives without the need for a legal designation. For instance, the company significantly contributes to community development, investing $26.5 million in 2020 on initiatives such as clean water projects in Argentina and education programs in North America. Additionally, the Environmental and Social Oversight Committee ensures sustainability considerations are embedded in decision-making processes, addressing stakeholder needs comprehensively.Barrick's approach also demonstrates a balance between financial returns and stakeholder impact. Dividends have tripled since 2018, and the company reported robust net earnings of $4 billion in 2019, underscoring that ESG integration enhances rather than hinders financial outcomes. Moreover, Barrick has achieved substantial progress in sustainability metrics, including a 30% reduction in greenhouse gas emissions in certain operations through solar energy adoption and efficient water recycling systems. These results showcase Barrick's ability to align with PBC principles, achieving societal and environmental benefits alongside financial performance, without requiring formal PBC status.
6	How should corporations address **societal concerns** such as **racial equity**?	Barrick Gold Corporation addresses societal concerns such as racial equity and diversity through structured policies and measurable actions aimed at fostering inclusivity, increasing workforce diversity, and empowering local communities. The company has made significant strides in promoting gender diversity, with women accounting for 17% of global new hires in 2021, up from 10% in 2020. Additionally, Barrick has set ambitious targets to ensure women represent 30% of its Board of Directors by 2022, reaching 27% by 2021, demonstrating its commitment to leadership inclusivity. Local hiring and socio-economic development are central to Barrick’s approach to reducing inequity. In 2021, 96% of its workforce consisted of host country nationals, and 78% of senior management positions were held by locals. The company distributed over $12.3 billion to employees, suppliers, and communities, with $1.65 billion specifically allocated to local suppliers near its operations. This reflects Barrick’s dedication to supporting economic empowerment and representation in the regions where it operates. Community empowerment and education initiatives further underline Barrick’s proactive stance on equity. The establishment of Community Development Committees allows local stakeholders to direct investment decisions, resulting in impactful projects such as entrepreneurship training in Mali and improved water access in Argentina. In 2021 alone, Barrick invested $26 million in community development. Moreover, the company

		supports future talent through technical training, education sponsorships, and gender-specific development programs, reinforcing its long-term commitment to societal equity.
7	How do you **develop** a **global approach** to ESG?	Barrick Gold Corporation has developed a structured global approach to ESG by embedding sustainability into its operations with a focus on governance, stakeholder engagement, and measurable outcomes. The company's sustainability strategy is anchored on four pillars: respecting human rights, protecting health and safety, sharing benefits with stakeholders, and managing environmental impacts. Governance is overseen by the Environmental and Social Oversight Committee (E&S Committee), which ensures alignment between site-level practices and corporate strategies through quarterly reviews. To measure and track progress, Barrick introduced the Sustainability Scorecard in 2019. This tool monitors key ESG metrics, allowing the company to achieve notable improvements, such as attaining ISO 45001 certification and biodiversity management plans. In 2021, Barrick achieved an 82% water reuse rate, exceeding its 80% target, and retained its B-grade ESG performance while demonstrating improvements in multiple areas. Regional empowerment further drives innovation, with individual mines like Kibali saving over 1.6 million litres of fuel in six months using battery technology, and North Mara implementing Community Development Committees to address local needs. Barrick's proactive climate action includes a roadmap to reduce greenhouse gas emissions by 30% by 2030 (from a 2018 baseline), with emissions already reduced by over 5% by 2021. Renewable energy projects, such as the Nevada 200MW solar plant and hydro projects in Africa, have contributed significantly to this progress. Global recognition of Barrick's ESG efforts includes being ranked in the 95th percentile among mining companies in the Dow Jones Sustainability Index for the 14th consecutive year in 2021, underscoring the company's alignment with international ESG standards.
8	How do you **build** an ESG framework that is future proofed for tomorrow's **economic realities**?	Barrick Gold Corporation builds a future-proof ESG framework by embedding sustainability into its operations, guided by robust governance structures, innovation, and measurable outcomes. Central to this framework is the Environmental and Social Oversight Committee (E&S Committee), which ensures alignment between site-level practices and corporate goals. The committee reviews ESG performance quarterly, addressing risks and prioritizing sustainability initiatives. Additionally, Barrick links short-term incentives for leaders to sustainability performance, reinforcing accountability and commitment to its ESG priorities. To track and improve performance, Barrick uses its Sustainability Scorecard, introduced in 2019, to benchmark progress across key ESG metrics. By 2021, significant achievements included obtaining ISO 45001 certification for health and safety and ISO 14001 certification for environmental management. Water reuse rates reached 82%, surpassing the 80% target and demonstrating effective resource efficiency. Barrick's roadmap to reduce greenhouse gas emissions by 30% by 2030 (from a 2018 baseline) also reflects its commitment to long-term climate action. By 2021, emissions were already reduced by over 5% through renewable energy projects like the Nevada solar plant and hydroelectric initiatives in

		Africa. Local empowerment and community investments are vital elements of Barrick's ESG approach. Community Development Committees enable local stakeholders to influence project investments, ensuring alignment with regional needs. In 2021, Barrick invested $26.5 million in initiatives such as water treatment plants in Argentina and education programs in Mali, fostering local economic resilience. This focus on governance, innovation, and community-centric initiatives positions Barrick as a leader in sustainability while adapting to tomorrow's economic realities.
9	How do you vet **company performance of ESG**?	Barrick Gold Corporation evaluates its ESG performance through a robust governance framework, ensuring transparency and accountability at all levels. The Environmental and Social Oversight Committee (E&S Committee) plays a pivotal role in reviewing ESG performance quarterly, aligning site-level practices with corporate goals. These reviews are further examined by the ESG & Nominating Committee to ensure adherence to sustainability policies, creating a strong oversight mechanism. The Sustainability Scorecard, introduced in 2019, benchmarks ESG performance across critical areas such as health and safety, environmental management, and social impacts. By 2021, Barrick maintained a B grade, reflecting significant improvements like achieving ISO 45001 certification for safety and reaching an 82% water reuse rate. These measurable outcomes demonstrate Barrick's commitment to continuous improvement and resource efficiency. Independent benchmarking further validates Barrick's ESG progress. The company has been included in the Dow Jones Sustainability Index (DJSI) for 14 consecutive years, ranking in the 95th percentile among mining companies. This recognition highlights top-tier performance in environmental reporting, water risk management, and human rights. Additionally, each mine conducts self-assessments against the Responsible Gold Mining Principles (RGMPs), addressing gaps with actionable plans to align with global ESG standards. This comprehensive approach ensures sustained improvements and alignment with global benchmarks.
10	How should corporations **navigate** the ever- **changing landscape of ESG**?	Barrick Gold Corporation navigate the evolving ESG landscape by leveraging robust governance structures, fostering innovation, and maintaining transparent reporting mechanisms. The Environmental and Social Oversight Committee (E&S Committee) plays a central role by providing quarterly oversight, ensuring that ESG priorities are integrated at both operational and executive levels. To reinforce accountability, Barrick linked 25% of long-term executive incentives to Sustainability Scorecard performance in 2021, highlighting the importance of ESG in strategic decision-making. Barrick also uses its Sustainability Scorecard to track critical ESG metrics and drive measurable progress. For example, the company achieved an 82% water reuse rate and made significant strides toward its target of a 30% reduction in greenhouse gas emissions by 2030 (from a 2018 baseline). Notable innovations, such as the 200MW solar plant in Nevada, further demonstrate Barrick's commitment to reducing carbon emissions and improving energy efficiency, aligning with global sustainability goals. In addition to governance and innovation, Barrick empowers local communities by establishing Community Development Committees and

		partnering with local suppliers. In 2021, the company invested $1.65 billion in local suppliers and allocated $26.5 million to community development projects, including clean water and education initiatives in host countries. By integrating ESG into its operational DNA and responding proactively to shifting global demands, Barrick has maintained its inclusion in the Dow Jones Sustainability Index (DJSI) for 14 years, ranking in the 95th percentile of mining companies in 2021. This approach ensures sustainable growth while building trust among stakeholders.

5 Conclusion

This white paper explores how Generative AI can streamline ESG (Environmental, Social, and Governance) reporting within financial services. Financial institutions face increasingly stringent compliance requirements, yet the absence of universally enforceable sustainable finance standards makes ESG reporting complex across industries and jurisdictions. Effective reporting demands extensive data processing, encompassing both structured numerical data and unstructured textual information. Generative AI presents a novel solution to these challenges by offering advanced decision-support capabilities, including document summarisation, data visualisation, multi-company analytics, and tailored report generation. Additionally, its flexible technical architecture allows organisations to adapt AI systems to their unique business needs and IT constraints. Key technical features include agility in response generation, support for multiple algorithmic models, user-friendly interfaces, and scalability for future expansion.

To illustrate its potential, we showcase a use case where a large language model (LLM) generates responses to common ESG-related analyst queries, demonstrating its ability to support compliance efforts. Beyond this, we integrate an LLM with a state-of-the-art vision model, transitioning from text-based inputs to verbal prompts for ESG reporting. This multimodal approach appears to enhance performance compared to using a language model alone. Notably, emphasising key terms within verbal prompts results in more precise and targeted responses, underscoring the potential of Generative AI to significantly simplify ESG reporting.

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