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# Exogenous Data Using Large Language Models Like ChatGPT

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## Abstract

This chapter explores the role and potential of Large Language Models (LLMs) like ChatGPT to process exogenous data for various applications through illustrations with GPTs and several useful plug-ins, as well as a practical use case. Exogenous data refer to data external to organization's traditional, usually internal, financial data collection processes and may include social media, online searches, networks, and news media. The aim of utilizing exogenous data in accounting and auditing is to complement traditional financial reporting and assurance methods by offering a more nuanced and comprehensive view of a company's activities, as well as enhancing the quality of reporting and audit processes. Stakeholders can improve their decision-making processes by integrating publicly available exogenous data into their analyses. Although exogenous data can provide valuable insights beyond traditional financial statements, acquiring such data might be expensive and time-consuming. Therefore, there is a need for effective tools like ChatGPT to facilitate the process of extracting and analyzing data.

**Keywords:** Exogenous data; large language models; ChatGPT; generative AI; financial reporting and assurance; ESG assurance; business measurement; fraud detection

# 1. Introduction to Exogenous Data and ChatGPT

## 1.1 Exogenous Data in Business

The value of exogenous data is inevitably increasing (Brown-Liburd et al., 2019; Cheong et al., 2022). Scholars emphasize the importance of supplementing company-generated data with a vast quantity of exogenous data. A variety of exogenous data can be used for measuring and assuring businesses (for overviews, see Appelbaum et al., 2023; Cheong et al., 2022). Examples of exogenous data include social media data, videos from cameras and drones, weather information, online search trends, web traffic data, social network data, and data from news media. Exogenous data can be collected on a real-time basis from sensors, search results, and target advertisement history (Cheong et al., 2022). Below, we review contemporary research that focuses on the potential uses of exogenous data in financial reporting and assurance, ESG (environmental, social, and governance) assurance, business measurement, and fraud detection.

**Enhancing financial reporting and assurance:** Exogenous data, including social media, online searches, and news media, introduce new avenues for business measurement and information assurance. Auditors are encouraged to use exogenous data to perform their risk assessment (Appelbaum et al., 2023). The use of exogenous data also enables more dynamic and real-time financial reporting and assurance processes. For example, auditors may get a better understanding of material business events, such as hacking incidents, environmental disasters, and geo-political conflicts, when using exogenous data for real-time monitoring of business activities (Cheong et al., 2022). However, auditors should validate data veracity and data provenance when using exogenous audit evidence (Appelbaum et al., 2023).

**Supporting ESG disclosure and performance evaluation:** The use of exogenous data is proposed to complement sustainability reporting. Exogenous data may play a crucial role in evaluating companies' sustainability performance by offering insights into environmental footprints, social interactions, and governance standards (Appelbaum et al., 2023; Cheong et al., 2022). For example, external data from ESG ratings can be used as a supplementary audit reference in the evaluation of corporate sustainability performance (Appelbaum et al., 2023). Using social media data, environmental information near a factory could be obtained, extracted, analyzed, and further used as audit evidence to verify sustainability reports (Gu et al., 2023a). Data is also needed to measure a company's sustainable risks and for assessing how well the company manages those risks. However, there are challenges related to fragmented and inconsistent data sources (Appelbaum et al., 2023).

**Improving business measurement with real-time data:** Cheong et al. (2022) argue that contemporary financial reporting and assurance have limited value in firm valuation in the digital world and that sources of more diversified, exogenous information facilitate new types of business measurement and information validation, such as continuous measurements of real-time processes (Huang et al., 2022). The emergence of various forms of exogenous data as proxies for business process measurement provides potential sources for state-of-the-art business reporting. For example, weather data could be used to predict sales revenue (Yoon et al., 2024), and social media posts could predict future changes in product sales (Dardani et al., 2024). Real-time exogenous data from sources like Google Maps and similarweb.com can assess business activities for both physical and e-commerce stores. Dardani et al. (2024) propose that new business measurements with future-oriented guidance could be developed based on exogenous data. Thus, business

decisions are not only influenced by traditional financial information, but various exogenous information can also determine the decision-making process.

**Fraud detection and misconduct identification:** In cases of fraud or misconduct, internal data often provide insufficient evidence. Exogenous data, such as social network information, can reveal cash flows, transaction contexts, and connections to counterparties, aiding efficient detection (Cheong et al., 2022). Furthermore, exogenous data, such as satellite images from a third-party, are less likely to be manipulated and could be used for assurance purposes in sustainability reports (Gu et al., 2023a).

Moreover, exogenous data enhances various stakeholders' ability to make informed decisions by providing a more comprehensive view of the company's performance and risks. For example, auditors can leverage exogenous data in their assessments, especially for ESG disclosures, by verifying them against established audit goals and regulatory norms. Investors are interested in more than the information obtainable in publicly available 10-K reports (Alles et al., 2022). For example, information about the company's employees, employee turnover rate, and loyalty can be derived from job service sites like Indeed or Glassdoor.com (Alles et al., 2022). Thus, various stakeholders can enhance their decision-making process by integrating publicly available exogenous data, such as environmental footprint information, diversity and equality insights, and product popularity measures from various online platforms, into their analyses. Stakeholders can significantly benefit from using exogenous data to make informed decisions, predict market trends, and identify investment opportunities.

Overall, prior studies emphasize the growing value of exogenous data in financial reporting, investment decision-making, and ESG assessments in providing a more holistic view of

a business's operations, sustainability, and market position. However, prior research also addresses the challenges involved in the collection, analysis, and integration of exogenous data with existing financial and non-financial data. While social media and other online sources offer real-time information, the tasks of cleaning, linking, and extracting useful information from exogenous data (big data) sources require significant computational resources and expertise. Duan et al. (2022) note that the voluminous, unstructured, and often textual nature of exogenous data presents a huge challenge for auditors in terms of quantitative analysis and integration of the data into the auditing workflow in a continuous manner. Furthermore, acquiring such data might be expensive and time-consuming. The case of Luckin Coffee (Cheong et al., 2022) illustrates that investigators collected exogenous data through labor-intensive manual processes. LLMs like ChatGPT, could facilitate an automated extraction of exogenous data.

## **1.2 LLMs and ChatGPT**

In 2018, the introduction of transformer-based architectures (Vaswani et al., 2017) marked a significant advancement in natural language processing (NLP). As a result, models like Google's BERT, OpenAI's ChatGPT, and Meta's LLaMa were developed. These LLMs use neural networks with billions and later trillions of parameters, and they are trained on vast amounts of text data through self-supervised learning to process and understand natural language. The algorithms learn semantic and syntactic relationships among words from a large volume of texts. This allows them to consider context, including other words in the same text and word sequences in summarizing texts (e.g., Huang et al., 2023). The LLMs are considered efficient and accurate in terms of understanding human language (Gu et al., 2023a; Huang et al., 2023).

In 2020, the introduction of OpenAI's GPT-3<sup>1</sup> was a significant developmental milestone for LLMs that advanced the field of NPL by providing a powerful tool for human-computer interaction through conversational dialogue (De Kok, 2023; Zhao and Wang, 2024). ChatGPT by OpenAI has become a key player in the realm of LLMs and has revolutionized the field of artificial intelligence (AI) with its advanced capabilities in understanding and generating human-like text (OpenAI, 2023a). In 2023, OpenAI announced the development of a new multimodal model called GPT-4, which can process both text and image inputs to produce text output (Dong et al., 2023; OpenAI, 2023b). The advent of GPT-4 marks a new milestone in AI, offering functionalities that were once considered exclusive to human intelligence (Dong et al., 2023).

Scholars argue that LLMs underline the growing significance of data in today's economy and suggest that technologies like LLMs that are able to analyze and interpret large datasets could play a crucial role in extracting insights and making informed decisions (e.g., Li et al., 2024). Furthermore, the utilization of AI will likely transform accounting practices substantially, resulting in enhanced efficiency in leveraging accounting data for decision-making within organizations (Zhao and Wang, 2024). Accounting scholars emphasize the potential abilities of ChatGPT to reshape various accounting processes by automating repetitive tasks, enhancing financial and managerial reporting and analysis, improving auditing and tax practices, and simplifying client interactions (Dong et al., 2023; Zhao and Wang, 2024). They mention, for example, ChatGPT's capabilities to extract and analyze relevant information, identify anomalies, and track reporting patterns. Saini (2023) and Huang et al. (2023) describe various reporting analysis scenarios in which ChatGPT is used for sentiment analysis. ChatGPT's insights could also be used for cost budgeting, retirement planning, risk management, and investment analysis (Son, 2023; Zhao and

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<sup>1</sup> GPT stands for Generative Pre-training Transformer. GPT is designed as an autoregressive model for language generation, and it works as a sequential language creation model predicting one word at a time (Dong et al., 2023).

Wang, 2024). In auditing, ChatGPT's capabilities could extend to risk assessment, compliance monitoring, and investment analysis. Gu et al. (2023b) propose the “co-piloted auditing” concept, indicating a collaborative partnership between auditors and AI models. Eulerich and Wood (2023) show concrete examples of how internal auditors could use ChatGPT in the internal audit process. Furthermore, ChatGPT's ability to process and analyze large datasets, provide real-time insights, and predict market trends make it a useful tool for businesses that seek to leverage AI for strategic decision-making (De Kok, 2023; Dong et al., 2023). Moreover, using AI for data analysis is often more cost-effective than traditional methods (Noy and Zhang, 2023).

## **2. Sources of Exogenous Data through ChatGPT**

This section explores various sources of exogenous data and shows how ChatGPT can facilitate this process for each data type. We propose that incorporating ChatGPT into the extraction and analysis of exogenous data sources can substantially enhance the efficiency and effectiveness of data-driven decision-making for investors, auditors, managers, and other stakeholders.

One of the most innovative aspects of ChatGPT is its ability to integrate with various plug-ins and GPTs, expanding its capabilities beyond mere text generation. These plug-ins and GPTs allow ChatGPT to perform specialized tasks, access external databases, and interact with different web services. The plug-ins and GPTs listed in Appendix 1 are some samples of specialized tools that can enhance ChatGPT's ability to interact with and interpret exogenous data.

## 2.1 News Analysis

News is a vital form of exogenous data because it encapsulates a wide array of information that reflects not only current events but also the perceptions, expectations, and sentiments of individuals, organizations, and market at large. When it comes to making informed decisions in the business world – whether for management, investment, or auditing purposes – news can provide real-time insights into factors that may influence a company's performance (Cheong et al., 2022). This includes but is not limited to changes in the political landscape, regulatory shifts, technological advancements, market trends, and emergent risks. For example, a news article about new tariffs could signal potential cost increases for manufacturers, whereas reports on a data breach could imply future expenditures and reputation damage for a tech firm.

Recent studies underscore the significance of AI, particularly ChatGPT, in analyzing news to gain financial insights. For instance, research by Dong et al. (2023) highlight the scope of ChatGPT's application in accounting and finance. Zhang (2023) reveals that sentiment scores from a GPT-3.5 model, based on Financial Times news titles and subtitles, predict stock market movements more effectively than traditional models like BERT. Comlekci et al. (2023) find that ChatGPT's forecasts for the financial performance and dividends of companies in the Borsa Istanbul 100 Index improve significantly when supplemented with recent industry news. These studies collectively illustrate how ChatGPT can be a valuable tool in transforming news into actionable business intelligence, aiding in strategic decision-making, investment analysis, and understanding the broader context of financial disclosures.

For example, by integrating plug-ins and GPTs shown in Appendix 1, ChatGPT could assist managers by summarizing the latest local or global news that could affect firms' strategic decisions, provide investors with an analysis of how recent corporate and economic events might

affect stock performance, and aid auditors in understanding and assuring the broader context of a company's financial disclosures. For instance, the Bitcoin Sentiment plug-in could offer cryptocurrency investors insights into the potential stock market movements based on media sentiment. By contextualizing news items, identifying trends, and flagging pertinent information, ChatGPT can act as a sophisticated aid to decision-making processes.

## **2.2 Social Media Insights**

Social media has emerged as an indispensable source of exogenous data due to its immediacy and the direct user engagement that it captures. It provides a real-time pulse for public sentiment, trends, and the collective voice of consumers, investors, and industry commentators. The emergence of social media as a critical source of exogenous data is emphasized in the work of Cheong et al. (2022), who discuss the increasing relevance of accounting information when combined with external data sources like Reddit, Twitter, Facebook, Instagram, and TikTok. Furthermore, analyzing sales trends across various products and the flow of textual data on social media platforms can provide early indicators of a product's popularity and potential issues (Vasarhelyi et al., 2015; Warren et al., 2015). Executives can refine their corporate tactics to align with customer feedback, investors can assess the collective mood to predict investment outcomes, and auditors can scrutinize online discourse for any signs of fiscal or reputational hazards. For companies, social media data can reveal insights into brand perception, the impact of marketing campaigns, customer satisfaction, and emerging market trends before they are encapsulated in traditional reporting metrics. This information is invaluable to managers, investors, and auditors because it can act as an early warning system for potential issues, as well as an opportunity detector for areas of growth and innovation.

Incorporating ChatGPT to analyze social media involves utilizing its advanced language models to process and understand the vast amounts of unstructured text data generated by social platforms. ChatGPT, enhanced with the specialized plug-ins and GPTs outlined in the Appendix 1, can interpret nuances in sentiment, track the spread of information, and identify the significance of social media discussions related to a specific company or sector. For instance, an analytics advisor plug-in can help to quantify the effectiveness of a social media strategy, whereas a sentiment analysis GPT can assist in understanding the public's perception of a recent corporate decision or product launch (shown in Appendix 1).

### **2.3 Web Traffic Data**

Web traffic data stands as a beacon of quantitative insight, shedding light on user behavior, engagement levels, and the effectiveness of online content and marketing strategies. For a company, understanding the nuances of this data can lead to improved user experience, more targeted marketing campaigns, and ultimately, increased revenue and growth. Such data includes metrics like page views, bounce rates, session duration, and conversion rates. When this data is analyzed, it can provide a comprehensive picture of how users interact with a company's online presence. In addition to the traditional web traffic metrics, the study by Cheong et al. (2022) expands the scope of data analysis by illustrating how real-time foot traffic data from sources like Google Maps can be instrumental in evaluating physical store performance.

ChatGPT can process web traffic data to identify trends, patterns, and anomalies. For instance, a plug-in like Avian could allow ChatGPT to pull in data from various advertising platforms and search engines, giving a holistic view of a company's online visibility and the performance of its marketing efforts (Appendix 1). With tools like AnalyticsAI, ChatGPT could

use simple prompts to interact with Google Analytics, simplifying the process of complex data analysis for managers who may not have deep technical expertise. The integration of ChatGPT with web traffic analytics equips decision-makers with a powerful tool and allows for a real-time understanding of the digital landscape. Managers can utilize these insights to determine the return on investment for digital campaigns, ensuring that resources are being allocated to the most effective strategies. Investors can understand a company's online presence and influence, which can be indicative of brand strength and market position. Auditors can cross-check reported web performance against actual data.

## **2.4 Weather Data and Predictions**

Weather data and predictions are crucial exogenous factors that can have profound impacts on a range of business operations. The relevance of weather information extends beyond its immediate effects on production schedules and logistics to its influence on consumer buying behavior, energy consumption patterns, and even financial markets. Yoon et al. (2024) demonstrate that the integration of weather data into substantive analytical procedures in audit testing can enhance the precision of revenue forecasts for companies whose operations are significantly influenced by weather conditions. In the retail sector, weather predictions can help companies anticipate changes in consumer demand for certain products, such as increased purchases of warm clothing during an unseasonal cold forecast. In agriculture, accurate weather predictions can inform planting and harvesting decisions, directly affecting crop yields and market supply. For investors, understanding how weather data correlates with market trends can inform investment decisions, especially in commodities, the agriculture, energy sectors, and insurance, where weather

plays a significant role. Auditors can also use weather data to validate the influence of weather events on financial performance and disclosures.

By incorporating ChatGPT with weather data plug-ins and tools, businesses can access personalized and actionable weather-driven insights. ChatGPT can interact with weather analytics tools, like those mentioned in Appendix 1, to process current, forecasted, and historical weather data. This can help in creating comprehensive business plans that account for the impacts of weather. For example, using a plug-in like Weather Meteosource, ChatGPT can provide real-time updates on weather conditions, allowing a logistics manager to reroute shipments to avoid delays due to unforeseen weather disruptions. Similarly, a tool like the Business Plan Builder can integrate weather data into broader strategic plans, helping businesses in weather-sensitive industries to mitigate risks or capitalize on weather-related opportunities.

## **2.5 Other Sources**

The current business environment is complex and multifaceted, with a myriad of exogenous factors that influence company performance and decision-making. Appendix 1 provides some examples of plug-ins and GPTs that could incorporate different kinds of exogenous data. For instance, AITickerChat, which extracts insights from SEC filings and conference call transcripts, offers valuable information on a company's strategic direction, market position, and management's perspectives. This data is critical for managers who need to understand their company's competitive environment and for investors who make decisions based on company performance and strategy.

Polygon provides a broad spectrum of market data, which is integral for understanding market dynamics and the interplay between different asset classes, including stocks, options,

foreign exchange markets (forex), and cryptocurrencies. ChatGPT can use such data to help decision-makers discern market trends and develop timely investment strategies or risk assessments. Furthermore, platforms like Quiver Quantitative provide unique insights into the financial activities of political figures, offering an additional layer of understanding regarding potential upcoming regulatory changes that could affect certain industries or markets. In the case of PointsRecap, daily updates and trading insights gleaned from YouTube content creators can give a real-time sense of investor sentiment and market reactions, which can be particularly useful for investors and traders looking to capitalize on short-term market movements. Similarly, PortfoliosLab's analytics can support more long-term, strategic planning and investment by providing detailed performance, volatility, and risk assessments.

Data from external sources like satellite imagery, which is less susceptible to managerial influence, can serve as a critical tool to reduce the risk of greenwashing and corroborate the authenticity of ESG disclosures. (Gu et al., 2023a) The Space Photo Explorer, with its access to extensive space imagery databases, could be leveraged as an exogenous data source to verify environmental claims independently and enhance the credibility of sustainability reporting. Finally, the Sustainability Assistant could help provide expert advice on ESG aspects, deliver updates on relevant sustainability regulations and trends, and help to prepare for future changes in ESG practices. It could also balance insights across environmental, social, and governance factors, offering non-binding, practical guidance tailored to specific company or industry needs.

### **3. An Illustrative Case**

We illustrate what exogenous data and information about greenhouse gas (GHG) emissions can be found when exploring ESG ratings provided by rating agencies as well as by testing some

of the plug-ins (provided in Appendix 1) for the ExxonMobil corporation. ExxonMobil was selected because of the recent news story in *Fortune* (2024) saying that two of the biggest shareholders want the oil giant to commit to more ambitious emissions reductions. ExxonMobil reacted by suing the Arjuna Capital and Follow This investor groups, emphasizing that the social responsibility of the firm is to increase profits, consistent with Milton Friedman's famous 1970 essay (Friedman, 1970). Another motivation for our choice is that GHG emissions constitute a material aspect in ExxonMobil's business operations based on SASB's standards and Materiality Finder (2023). Moreover, Appelbaum et al. (2023) regard the physical risk, transition risk, and liability/legal risk levels of companies operating as energy providers and chemical manufacturers as high in all three risk categories. Given the high risk levels and materiality aspects, it is important for shareholders and other stakeholders to take a closer look at ExxonMobil's disclosures and complement reported financial and non-financial information with data derived from exogenous sources.

First, we explore what information shareholders can access by using available corporate reports. We asked ChatGPT to summarize the main issues related to emissions in ExxonMobil's 10-Ks (annual reports) for 2022 and 2023. The result is included in Appendix 2. The text includes information about (1) emission-reduction investments and strategies, (2) GHG emission targets, (3) financial impacts of emission policies, (4) risks related to lower-emission business opportunities, (5) climate change and energy transition, (6) regulatory and litigation risks, and (7) decarbonization technologies and policies. We also asked ChatGPT to summarize the main issues related to emissions in the sustainability report of ExxonMobil for the last few years. As shown in Appendix 3, we received a brief overview (excluding numerical information) related to the

following issues: (1) GHG emissions data, (2) emission reduction goals and progress, (3) third-party assurance, and (4) forward-looking statements.

As Appelbaum et al. (2023) note, ESG ratings provided by third-party rating agencies are considered objective and informative exogenous data. We extract ESG and Emissions ratings from the LSEG Workspace (previously Refinitiv) for ExxonMobil and the peer firm British Petroleum (BP). Table 2.1 shows that ExxonMobil’s ESG and Emissions scores are lower than the comparable scores for BP on a scale from 0 to 100. According to LSEG Workspace, a score of more than 70 is considered good, so the difference in scores seems not to be significant. Table 2.1 also includes other information related to emissions, but information about the total Scope 3 emissions is not available for either company. However, it is notable is that the numbers provided by BP related to “Upstream scope 3 emissions Fuel- and Energy-related Activities” are very high and also much higher than the firm’s total scope 1 and 2 emissions, indicating that Scope 3 emissions are material to this industry sector. Finally, BP’s target year for emission reductions is 2025, whereas ExxonMobil’s latest target is 2030. While exogenous data available in databases like LSEG Workspace is easy to find and extract, users must usually obtain a license to get access to such databases, and data is updated only after considerable delay. Therefore, we further explore information that can be found using the plug-ins provided in Appendix 1.

**Table 2.1. Extract of Emission Information from the LSEG Workspace**

Emissions Data (LSEG Workspace)	ExxonMobil			British Petroleum Company p.lc (BP)			
	Year	2020	2021	2022	2020	2021	2022
ESG Score		77.56	73.25	N/A	86.37	89.96	87.17
Emissions Score		85.85	84.12	N/A	92.05	93.61	92.12
CO2 Equivalents Emission Direct (Scope 1)		95,000,000	96,000,000	N/A	41,700,000	33,200,000	30,400,000
CO2 Equivalents Emission Indirect (Scope 2)		7,000,000	7,000,000	N/A	3,200,000	2,400,000	2,100,000
CO2e Indirect Emissions Scope 3		N/A	N/A	N/A	N/A	N/A	N/A
CO2 Equivalents Emission Total (Scope 1 & 2)		102,000,000	103,000,000	N/A	44,900,000	35,600,000	32,500,000
Upstream scope 3 emissions Fuel- and Energy-related Activities		N/A	N/A	N/A	327,600,000	303,600,000	306,700,000
Total emission intensity (Total emissions per Net sales)		0.571	0.372	N/A	0.247	0.225	0.127
Emission Reduction Target Year		2050	2030	N/A	2025	2025	2025

We test the Sustainability Assistant and WebPilot plug-ins to explore whether additional information related to ExxonMobil's emissions and risks can be extracted. The results are found in Appendix 4 and 5. For example, we find more details related to risks that were not available in the corporate notes to 10-Ks or in the LSEG database. Risks mentioned in Appendix 5 are, for example, risks for additional costs-related legal actions against shareholders who demand faster climate action, risks for assets being at risk of impairment due to climate change, and overall environmental and regulatory risks that may affect the company's long-term sustainability and legal standing. ChatGPT also provides some guidelines to shareholders. For example, as a shareholder of ExxonMobil, it is crucial to recognize the company's substantial efforts to enhance transparency and reduce emission, as detailed in its sustainability reports and ESG-related news. These efforts include significant investments in lower-emission technologies and carbon capture projects that align with evolving environmental and shareholder expectations. However, shareholders should remain vigilant about potential risks related to transparency, investor relations, and the company's adaptation to regulatory and market changes in the context of environmental sustainability. Thus, we maintain that using plug-ins and ChatGPT may provide complementary information to what is available in corporate reports and third-party databases.

#### **4. Conclusion and Future Outlook**

This chapter has explored the role and potential of LLMs like ChatGPT in processing exogenous data, as illustrated in the case of ExxonMobil. The evolving role of ChatGPT, particularly in the context of exogenous data, is characterized by its increasing capability to process and analyze data from diverse external sources. This study delves into an array of exogenous data types that ChatGPT can help stakeholders to leverage. It details how ChatGPT's integration with various

plug-ins and GPTs can streamline the processing and interpretation of data from news, social media, web traffic, and weather predictions to aid in informed decision-making. The integration of a wide array of exogenous information into existing financial and non-financial data provides stakeholders with a competitive edge and a means to ensure that decisions are as informed and strategic as possible.

By using ChatGPT to assimilate and analyze diverse data streams, managers, investors, and auditors can gain a richer, more detailed picture of a company's context within its industry and the broader economy. ChatGPT can help to translate vast amounts of data into actionable insights, a process that is essential for effective decision-making in today's business environment. This signifies a shift towards a more data-driven approach in business, where AI not only supports but also guides strategic planning and operational decisions.

While ChatGPT and similar AI technologies offer significant benefits, there are also challenges and ethical considerations that must be carefully managed. One of the primary concerns with ChatGPT is data privacy and security. Since these models are trained on vast datasets, including potentially sensitive information, there is a risk of data breaches or misuse of personal data (Munoko et al., 2020; Zhao and Wang, 2024). The issue of transparency and accountability in AI decision-making is another area of concern (Dong et al., 2023). As AI models like ChatGPT become more complex, understanding how they arrive at certain decisions or outputs becomes more challenging. Despite their advanced capabilities, AI models like ChatGPT have limitations in understanding context and nuance, especially in complex or ambiguous situations. This limitation can lead to errors or misunderstandings (Li et al., 2024). Furthermore, ChatGPT has been found to generate factually incorrect or entirely made-up information, a phenomenon known as hallucination (Dong et al., 2023). However, regardless of whether the data was collected

manually or using ChatGPT, the effectiveness and reliability of the exogenous data must be assessed continuously (Cheong et al., 2022).

As research continues, the capabilities of ChatGPT and similar models are expected to expand, enhancing their role in business intelligence and decision-making. Future research in AI, especially in the context of exogenous data, is expected to focus on enhancing the precision and contextual understanding of AI technologies. This means improving the algorithms' ability to pick out nuances and patterns in large data sets, thereby providing more accurate and actionable insights for businesses, accounting professionals and a variety of other stakeholders. Addressing the challenges of data privacy, security, and ethical considerations in AI will also be crucial in ensuring responsible and effective use of ChatGPT.



















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## Appendix 1. Examples of Sources of Exogenous Data through ChatGPT

Sources of Exogenous Data	Name of Plugins/GPTs	Icon	Description of the Functions
News	<i>News</i>		The most popular global news app, digest 80,000+ trusted sources for the latest news, trends, and insights in a flash.
	<i>Alpha News</i>		Alpha News provides access to >80k news sources, letting you search for topics, publications, and trending stories.
	<i>WebPilot</i>		Browse Webpage/PDF/Data. Chat and write with one/many/none URLs. WebPilot.ai Powered.
	<i>NewsBreak</i>		Learn about the most popular local or national news and find local businesses and events in the United States.
	<i>Risk Factors for listed companies</i>		This tool analyzes real-time news against NASDAQ 100 companies' SEC-reported risks, aiding informed investment decisions.
	<i>Corporate OSINT &amp; Competitor Analyst</i>		Provides strategic insights into market trends, competitor analysis, and critical intelligence for business decisions.
	<i>Bitcoin Sentiment</i>		Track the current price of Bitcoin and the market sentiment based on the last 20 news media mentions.
Social Media	<i>Social Search</i>		The Social Search provides access to tweets, users, followers, images, media and more.
	<i>Social Media Analytics</i>		Discover insights with social media analytics tools, social media monitoring tools, Facebook analytics tools, Instagram analytics tools, Twitter analytics tools, and LinkedIn analytics tools. Elevate your online strategy efficiently.
	<i>Social Media Analytics Advisor</i>		Analyzes and interprets social media data to drive strategic decisions.
	<i>Sentiment Analysis GPT</i>		Performs a detailed sentiment analysis on text to uncover hidden patterns.
	<i>Comments Analyzer</i>		This tool analyzes YouTube comments in seconds, providing trend analysis, sentiment checks, and valuable feedback. It could be extended to other social media platforms for similar analyses.
Web Traffic Data	<i>Avian</i>		Analyze & visualize data from 20+ platforms, including Google Analytics, Google Ads & Facebook Ads.
	<i>Cloudflare Radar</i>		Get real-time insights into Internet traffic patterns and threats as seen by Cloudflare.
	<i>AnalyticsAI</i>		Connect to your Google Analytics and get data with AI using simple prompts.
	<i>A/B Analytics</i>		A/B test and analyze data from Google Analytics, Facebook Ads and more.
	<i>Cloudflare Radar</i>		Get real-time insights into Internet traffic patterns and threats as seen by Cloudflare.
	<i>Weather Meteosource</i>		Accurate weather for chat-based insights - current, forecasted, and historical. Updated in real-time.

<b>Weather Data and Predictions</b>	<i>Business Plan Builder</i>		Assists with creating business plans that could include weather data as an exogenous factor, especially in industries like retail, where weather can significantly impact consumer behavior.
	<i>Weather</i>		Get the weather forecast for a US city or zip code. Predicting, planning, and adapting to the weather forecast via contextualized chat-based insights.
	<i>Weather Report</i>		Current weather data for cities and airports using METAR aviation feeds.
	<i>MixerBox Weather</i>		Get real-time worldwide weather updates & forecasts, instantly.
<b>Others</b>	<i>AITickerChat</i>		Retrieve USA stock insights from SEC filings as well as Earnings Call Transcripts.
	<i>Polygon</i>		Market data, news, and fundamentals for stocks, options, forex, and crypto from Polygon.io.
	<i>Quiver Quantitative</i>		Access data on congressional stock trading, lobbying, insider trading, and proposed legislation.
	<i>PointsRecap</i>		Daily stock market updates, trading insights and view points summary from YouTube traders.
	<i>PortfoliosLab</i>		Stocks, ETFs, funds, crypto analysis: historical performance, volatility, risk metrics, Sharpe ratio, drawdowns, etc.
	<i>Space Photo Explorer</i>		Tool for exploring space through images including Mars Rover Photos, NASA image database, and space pictures of the day.
	<i>Sustainability Assistant</i>		ESG & Sustainability helper that provides regulatory updates, industry news, and advice on creating a more sustainable organization

## Appendix 2. Example Using GPT-4 to Extract Information from 10-K

*Prompt:* Could you read the file of ExxonMobil annual report 2022 and 2023 and summarize the 5-7 main issues related to emissions mentioned in the 10-K for these years? Please cite some original texts for each issue.

*Answer:*

Based on the 2022 and 2023 ExxonMobil annual reports, here are the main issues related to emissions:

1. *Emission-Reduction Investments and Strategies:* ExxonMobil is increasingly focusing on lower-emission business opportunities, including carbon capture and storage, hydrogen, and lower-emission fuels. They expect environmental expenditures to rise significantly due to these initiatives, with estimated costs of about \$7.3 billion in 2023 and \$8.2 billion in 2024.
2. *Greenhouse Gas Emission Targets:* The company aims for substantial reductions in greenhouse gas emissions. By 2030, ExxonMobil plans to achieve a 20-30% reduction in corporate-wide greenhouse gas intensity, a 40-50% reduction in upstream intensity, a 70-80% reduction in methane intensity, and a 60-70% reduction in flaring intensity. They also target net-zero greenhouse gas emissions (Scope 1 and 2) from unconventional operations in the Permian Basin by 2030.
3. *Financial Impacts of Emission Policies:* ExxonMobil's financial results are significantly influenced by government policies and market developments related to emissions. The company includes estimated costs for reaching its greenhouse gas emission-reduction goals in its financial assessments, even in areas without current greenhouse gas pricing policies.
4. *Risks Related to Lower-Emission Business Opportunities:* The company acknowledges that the success of their lower-emission initiatives, like carbon capture and hydrogen fuels, is dependent on market growth and supportive government policies. Uncertainties in technology development and policy changes present risks to their business plans.
5. *Climate Change and Energy Transition:* ExxonMobil is aware of the global shift towards lower-emission energy sources and net-zero scenarios. The company aims to adapt and lead in the energy transition while considering the uncertainties in technology, policies, and market developments related to climate change.
6. *Regulatory and Litigation Risks:* The company faces risks from changing environmental regulations and policies, which can increase compliance costs and affect business strategies. Government actions like carbon taxes, trade tariffs, and efficiency standards impact their operations and product competitiveness.
7. *Decarbonization Technologies and Policies:* The decarbonization of industrial activities is crucial, requiring advancements in technologies like carbon capture and storage, hydrogen-based fuels, and lower-emission solutions. ExxonMobil emphasizes the importance of

supportive policies and technology development for achieving broader emission reduction goals.

These points highlight ExxonMobil's increasing focus on reducing emissions, the financial implications of these efforts, and the challenges and risks associated with transitioning to a lower-emission business model.

### **Appendix 3. Example Using GPTs- “Sustainability Assistant” to Analyze ExxonMobil’s Sustainability Reports**

*Prompt:* Could you read the ExxonMobil’s sustainability reports for the last few years disclosed information about emissions?

*Answer:*

In recent years, ExxonMobil's sustainability reports have provided detailed information on their greenhouse gas (GHG) emissions, demonstrating their commitment to transparency in this critical aspect of their ESG performance. Here are some key points from these reports:

1. *Greenhouse Gas Emissions Data:* ExxonMobil's reports include comprehensive data on their Scope 1, Scope 2, and, where applicable, Scope 3 GHG emissions. This includes metrics like CO<sub>2</sub> and CH<sub>4</sub> emissions across different operational segments such as upstream, downstream, and chemical.
2. *Emission Reduction Goals and Progress:* The company has been making concerted efforts to reduce its GHG emissions. Their 2030 greenhouse gas emission reduction plans are incorporated into medium-term business strategies. They include ambitious targets such as achieving net-zero emissions for operated assets by 2050 and substantial reductions in methane and flaring intensity.
3. *Third-Party Assurance:* ExxonMobil's GHG emissions inventory and performance data are audited for compliance with recognized standards like ISO 14064-3, providing an additional layer of credibility to their reported figures.
4. *Forward-Looking Statements:* The reports also contain forward-looking statements about future ambitions and goals regarding emissions reduction. However, these statements are subject to numerous factors such as market conditions, technological progress, policy support, and regulatory changes.

It's important for stakeholders, including investors, to understand that these reports are based on the best available data and methodologies, which continue to evolve. Therefore, the figures and projections should be considered in the context of potential uncertainties and changing market and policy landscapes.

For detailed information and specific data, you can refer to ExxonMobil's Sustainability Report and Advancing Climate Solutions Report on their official website.

## Appendix 4: Example Using GPTs- “Sustainability Assistant” to Extract and Analyze ESG-related News about ExxonMobil

*Prompt:* Could you tell me some ESG-related news about ExxonMobil in the past few years? If I'm a shareholder of ExxonMobil, do you have any further suggestions/takeaways for me?

*Answer:*

In recent years, ExxonMobil has taken significant steps in addressing ESG-related concerns. Here are some key developments:

1. *Investment in Lower-Emissions Initiatives:* ExxonMobil announced plans to invest \$17 billion through 2027 in lower-emission technologies and initiatives, including their Low Carbon Solutions business. This is a clear indication of the company's commitment to transitioning towards a more sustainable energy future.
2. *Focus on Carbon Capture and Storage (CCS):* They have been actively involved in projects related to carbon capture and storage. Notably, ExxonMobil partnered with Shell and the Government of Singapore to create a carbon capture and storage value chain. This kind of collaboration underscores the company's dedication to innovative solutions for reducing carbon emissions.
3. *Strategic Corporate Moves:* ExxonMobil has been evolving its business strategy to align more closely with ESG goals. This includes their merger with Pioneer Natural Resources in an all-stock transaction, which likely has implications for their approach to sustainable energy practices.
4. *Activist Influence on Board Composition:* A significant ESG-related event for ExxonMobil was the successful campaign by Engine No. 1, an activist investment firm, to place three dissident members on ExxonMobil's board in 2021. This event highlighted the increasing influence of shareholder activism focused on ESG issues, particularly climate change.

As a shareholder, these developments suggest that ExxonMobil is actively responding to ESG pressures and is making efforts to adapt to a changing energy landscape. This transition includes investing in new technologies and reevaluating traditional business strategies.

However, as an investor, it's important to stay informed about the effectiveness of these strategies and how they align with overall market trends and regulatory changes. Balancing the potential risks with the opportunities presented by these ESG-focused changes is crucial for making informed investment decisions.

For more detailed information, you might want to regularly check ExxonMobil's sustainability updates and press releases:

<https://esgnews.com/esg/exxonmobil/>

<https://investor.exxonmobil.com/esg>

<https://hbswk.hbs.edu/item/esg-activists-met-the-moment-at-exxon-mobil-but-did-they-succeed>

## Appendix 5. Example Using plug-in “WebPilot” to Extract and Analyze ESG-related News about ExxonMobil

*Prompt:* Greenhouse gas (GHG) emissions constitute a material aspect in ExxonMobil’s business operations. Further, previous research regards the physical risk, transition risk, and liability/legal risk levels of companies operating as energy providers and chemical manufacturers as high on all three risk levels. Please read the ExxonMobil’s related news for the last few years and tell me what you find about its risks. And if I'm a shareholder of ExxonMobil, what are the corresponding suggestions/ takeaways? Please include the references you use.

*Answer:*

Recent news about ExxonMobil highlights several key risks and developments:

1. *Streamlining Operations:* ExxonMobil has been restructuring to enhance effectiveness, grow value, and reduce costs. This indicates a strategic shift to improve operational efficiency and adapt to changing market conditions.
2. *Climate Change Acknowledgment and Action:* There have been reports that ExxonMobil internally acknowledged the impact of fossil fuels on climate change while publicly downplaying these risks. This raises concerns about transparency and corporate responsibility.
3. *Legal Actions Against Investors:* ExxonMobil has been involved in legal actions against investors who demand faster climate action. This suggests potential conflicts between the company's operational strategies and investor expectations regarding environmental responsibility.
4. *Asset Risk Due to Climate Change:* ExxonMobil has warned that some of its assets may be at risk of impairment due to climate change. This indicates a recognition of the physical risks posed by climate change to its operations.
5. *Advanced Recycling Initiatives:* The company has been investing in 'advanced recycling' plants, which could be part of its strategy to address environmental concerns. However, the environmental efficacy of these initiatives has been questioned.

For a shareholder of ExxonMobil, these developments suggest several takeaways:

1. *Need for Vigilance on Corporate Strategy:* The restructuring and streamlining efforts indicate that ExxonMobil is adapting to market and operational challenges. Shareholders should monitor how these changes impact the company's profitability and market position.
2. *Environmental and Regulatory Risks:* The issues around climate change acknowledgment and legal actions highlight the environmental and regulatory risks facing ExxonMobil. Shareholders should consider how these risks might affect the company's long-term sustainability and legal standing.
3. *Investor Relations and Corporate Governance:* The conflict with investors over climate action underscores the importance of strong investor relations and corporate governance.

Shareholders should assess how ExxonMobil manages these aspects and their potential impact on the company's reputation and shareholder value.

4. *Innovation and Diversification*: Investments in advanced recycling and other new technologies indicate ExxonMobil's efforts to innovate and diversify. Shareholders should evaluate the potential of these initiatives to contribute to the company's growth and environmental goals.
5. *Long-Term Outlook*: Given the evolving landscape of the energy sector, shareholders should consider the long-term outlook of ExxonMobil, including how it plans to navigate the transition to a lower-carbon economy and manage associated risks.

Overall, shareholders of ExxonMobil should stay informed about these developments, assess their implications, and consider how they align with their investment goals and risk tolerance.

Here are the references for the information provided:

1. *ExxonMobil Streamlines Structure*: This information was derived from ExxonMobil's news release about their efforts to streamline operations to enhance effectiveness, grow value, and reduce costs.

ExxonMobil streamlines structure to enhance effectiveness, grow value, reduce costs.  
[https://corporate.exxonmobil.com/news/news-releases/2022/0131\\_exxonmobil-streamlines-structure-to-enhance-effectiveness-grow-value-reduce-costs](https://corporate.exxonmobil.com/news/news-releases/2022/0131_exxonmobil-streamlines-structure-to-enhance-effectiveness-grow-value-reduce-costs)

2. *Climate Change Acknowledgment and Action*: Reports indicating that ExxonMobil internally acknowledged the impact of fossil fuels on climate change while publicly downplaying these risks were found in news articles from sources like NPR.

Exxon minimized climate change internally after conceding that fossil fuels cause it.  
<https://www.npr.org/2023/09/14/1199570023/exxon-climate-change-fossil-fuels-global-warming-oil-gas>

3. *Legal Actions Against Investors*: Information about ExxonMobil's legal actions against investors demanding faster climate action was reported by NPR.

ExxonMobil is suing investors who want faster climate action.  
<https://www.npr.org/2024/02/29/1234358133/exxon-climate-change-oil-fossil-fuels-shareholders-investors-lawsuit>

4. *Asset Risk Due to Climate Change*: Reuters reported on ExxonMobil's warnings that some of its assets may be at risk of impairment due to climate change.

Exxon warns some assets may be at risk for impairment due to climate change.  
<https://www.reuters.com/business/energy/exxon-warns-some-assets-may-risk-impairment-due-climate-change-filing-2021-11-03/>

5. *Advanced Recycling Initiatives*: The Guardian provided information on ExxonMobil's investment in 'advanced recycling' plants and the environmental questions surrounding these initiatives.

Exxon's new "advanced recycling" plant raises environmental concerns.

<https://www.theguardian.com/us-news/2023/apr/10/exxon-advanced-recycling-plastic-environment>

These sources were used to gather the latest information and insights about ExxonMobil's operations, strategies, and the risks they face, particularly in relation to climate change and environmental sustainability.