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ORIGINAL ARTICLE

Impacts of reserve and decommissioning disclosures on value and performance of oil and gas firms listed in the UK

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Abstract

Oil and gas reserves and asset decommissioning are the most significant cash flow indicators of the oil and gas industry. Investors use disclosures by oil and gas firms to estimate future cash flows. Thus, this study examines impacts of oil and gas reserve disclosures and disclosures of decommissioning costs of oil and gas assets on the financial performance and value of listed oil and gas companies in the UK. We survey data from 52 listed firms. We conclude that whilst mandatory and voluntary reserve disclosures *negatively* impact firms' performance, they *positively* impact value. Mandatory decommissioning disclosures are *positively* related to performance and value. Voluntary decommissioning disclosures *negatively* correlate with firms' value, but *positively* relate with firms' performance. These findings contribute to the debate around the usefulness and impacts of oil and gas reserves disclosures and disclosures of decommissioning costs of oil and gas assets on companies values and performance.

Keywords Oil and gas · Reserves · Decommissioning · Disclosure · London stock exchange

Introduction

Stakeholders, such as investors and governmental agencies, require accounting disclosures for decision-making (Byard and Shaw 2003; De Abreu et al. 2016). Given their significant cash flow effects, oil and gas reserves and decommissioning costs of oil and gas structures are significant for oil and gas companies (Odo et al. 2016; OGA 2020a, b[1]). However, companies may not disclose sufficient information on these two items (Standard and Poor 2007; Abdo et al. 2017, 2018). Disclosures are likely to impact company value and performance (see Aboody 1996; Gordon et al., 2010; Oluwagbemiga 2014; Abdel-Azim and Abdelmoniem 2015; McChlery et al. 2015; Patatoukas et al. 2015). These disclosures may offer positive or negative signals to investors regarding firm profitability and market values. In this context, while new oil and gas discoveries signal positive impacts on company's future cash flow and profits, decommissioning-related disclosures signal negative impacts on future cash flows and profits. Hence, this study probes the impacts of oil and gas reserve and decommissioning-related costs' disclosures on the value and performance of listed exploration and production (E&E) oil and gas firms in the UK. The aim is to investigate the extent to which these disclosures impact value and performance of these disclosure. In so doing, we also examine the effect of underlying firm characteristics on the level of disclosures.

Several studies on accounting disclosures by oil and gas companies investigate oil and gas reserves disclosures (e.g., Cooper et al. 1979; Dharan 1984; Lys 1986; Craswell and Taylor 1992; Boone 1998; Berry and Wright 2001; Mirza and Zimmer 1999; Berry et al. 2004; Taylor et al. 2012; McChlery et al. 2015; Odo et al. 2016). Studies-related decommissioning cost disclosures addressed compliance, quality, and limitations of such disclosures (e.g., Russell et al. 1998; Ekins et al. 2006; Rogers and Atkins 2015; Abdo et al. 2017, 2018; Abdo and Mangena 2018). None of these

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studies have measured the impact of decommissioning costs disclosures on firm performance and value. Unpacking the impact of disclosures on reporting company's value and performance is essential, given their opposite signals and significant impacts on oil and gas company cash flows. We came across no study that examined the impact of both of oil and gas reserve and decommissioning costs disclosures in one piece. Whilst having opposing impacts on companies' cash flow, disclosures of oil and gas reserves on the one hand and disclosures of decommissioning costs on the other hand offer important signals to the investing communities with regard to value and performance of oil and gas companies. Accordingly, this research bridges the gaps in the literature and is tasked with addressing impacts of these two items of disclosures on value and performance of 52 upstream exploration and production oil and gas companies listed on the main and alternative London stock exchange (LSE).

Under current technological, operating, and economic conditions, oil and gas reserves are estimations of the quantities that can be retrieved reasonably over a long period (Pedraza 2019). Decommissioning means restoring an industrial site to its initial pre-extraction state, withdrawing extraction equipment when reserves exhaust their constructive life (Abbagnara 2016). Since new explorations of commercial reserves means oil and gas companies would sustain and enhance their future sales revenues and profits; therefore disclosures of oil and gas reserves can positively enhance the value and performance of these reporting companies (Dharan 2004). However, decommissioning disclosures, representing a significant financial risk and cash outflows of oil and gas companies are likely to negatively impacts companies' values and performance (Standard and Poor, 2007; Rogers and Atkins 2015; Abdo et al. 2018). Such significance of these two disclosure items is undeniable. In this context, approximately 20 billion barrels of oil remain in the United Kingdom Conferential Shelf. However, decommissioning costs of infrastructures in the UK are approximately £48 billion (OGUK 2020).

Disclosures of oil and gas reserves and decommissioning costs-related information are key requirements of oil and gas companies, given their significant cash flow impacts (see Dharan 2004; Standard and Poor 2007; Rogers and Atkins 2015; McChlery et al. 2015; Monciardini 2016; Antonas and Hammerson 2016; Abdo et al. 2018). Hence, investors and other stakeholders rely on the disclosures of oil and gas firms to determine an estimated future cash flow that would translate into the value of the reporting entity (Odo et al. 2016; Abdo et al. 2018).

This study extends the reserve (e.g., Ani et al. 2015; McChlery et al. 2015; Odo et al. 2016) and decommissioning (e.g., Abdo et al. 2017, 2018) disclosure-related literature by adding a new constructed disclosures index for mandatory and voluntary items of cash-inflow and cash-outflow. In addressing the impact of *mandatory and voluntary* decommissioning and reserve disclosures on oil and gas firms' performance and value, this study raises the following research question: To what extent do voluntary and mandatory disclosures of a) decommissioning costs and b) oil and gas reserves both impact the financial *performance* of upstream oil and gas companies listed on the London Stock Exchange (LSE[2])? To what extent do voluntary and mandatory disclosures of a) decommissioning costs and b) oil and gas reserves both impact the *value* of upstream oil and gas firms listed on the LSE?

The remainder of the paper is structured as follows. "Literature review" section reviews relevant studies on measuring the level of disclosure and related theories. "Research design" section presents the research design. "Data" section reports the data, analysis, and discussion. "Empirical results" section 5 reports the empirical analysis. "Discussion" section resents the discussion of the findings. "Conclusion" section concludes the paper.

Literature review

Types of disclosures

The Statement of Recommended Practice (SORP)[3] guides additional voluntary disclosures in the UK oil and gas industry (McChlery et al. 2015). Odo et al. (2016) posit that the uncertainty surrounding the reserve estimation of oil and gas and the costs associated with the collection of reserve data discourage sufficient disclosure of data that satisfies the requirements of SORP, particularly in situations where the disclosure is discretionary. Therefore, insufficient disclosures by oil and gas companies regarding reserves and decommissioning may rob stakeholders, particularly investors, of adequately understanding the impact of newly discovered and expiry of oil and gas reserves and decommissioning obligations on the value and performance of oil and gas companies (see Russell et al., 1998; McChlery et al., 2015; Rogers and Atkins, 2015; Odo et al. 2016; Abdo et al. 2017 and 2018). Thus, without the means for sound investment decisions, they resort to complex financial analysis and stock market broker services, which may cost them high premium.

[2] The London Stock Exchange (LSE) is divided into two markets: the Main Market (Main), where large and more mature or established companies are listed, and the Alternative Investment Market (AIM), the market for smaller and growing companies with limited history.

[3] The UK's Oil Industry Accounting Committee formulates the SORP. Updated last in 2001, it is no longer mandatory.

The empirical literature

Most relevant empirical studies measure disclosure by identifying variables that might have a relationship with the disclosure level such number of words used, number of sentences or number of pages and graphs (Hassan and Marston 2019). This study hinges on three related literature themes: oil and gas reserve disclosures, decommissioning oil and gas assets disclosures, and firm performance and value. Based on the literature, mandatory and/or voluntary decommissioning and reserve disclosures affect the value and performance of the upstream listed oil and gas companies in the UK. Moreover, the firm-specific characteristics impact the relationship between disclosure level and the firm value and performance (see McChlery et al. 2015; Odo et al. 2016).

Boone (1998) explains that the financial reports of oil and gas firms, based on historical cost accounting, have serious deficiencies for lacking a necessary linkage between the historical cost of discovering reserves and the quantified future values of these reserves. Investors may not easily predict future cash flows via historical costs, given the significant role of reserve quantities in determining future production. Accordingly, McChlery et al. (2015) explain that the market value of an oil and gas firm stems from the company's physical reserve quantum, which normally is not indicated as part of the company's assets. Further, decommissioning costs of oil and gas installations are not clearly disclosed by oil and gas companies (Abdo et al. 2018) but are mostly included as part of other accounting provisions on the balance sheet. Decommissioning costs are significant future expenses and must be adequately disclosed from the beginning of the installation stage (Khurana et al. 2001; Rogers and Atkins 2015). However, decommissioning costs estimated by oil and gas firms are subject to subjective and uncertain judgements by engineering and relevant expertise (Abdo and Mangena 2018). Thus, reserves and decommissioning disclosures help determine value and performance based on future expected in and out cash flow in oil and gas firms.

Disclosure of oil and gas reserves

Annual changes in proved oil reserves[4] comprise new discoveries and extensions, improved recovery, revisions of prior quantity estimates, production, and sales and purchases of reserves (Spear 1994). Given the cash flow predictability power, such changes must be communicated to stakeholders via reserve disclosures. Thus, the failure to communicate the net reserves would induce misjudgement of a company's present value and future performance. In many cases, the disclosed information on the reserve quantity may not be accurate or reliable but contain information relevant for decision-making by investors (Wright and Brock 1999). It usually manifests when oil and gas firms need financing through the capital market or financial institutions. Hence, the level of disclosure and its quality become primary factors in the subjective decisions of the investors to provide the additional capital required. Higher reserve quantities mean the company, through production, can pay the principal debt and the interests accrued, qualifying for financing.

The oil and gas business is subject to risk factors such as oil spills or reputation damages. Thus, oil and gas firms more likely to disclose the balance of their reserve quantum with significant increases in quality to mitigate such risks (McChlery et al. 2015). Moreover, disclosures of oil and gas reserves indicate the reporting firm's financial position and future cash flows and, hence, financial performance and market value (Spear 1994; Oluwagbemiga 2014). McChlery et al. (2015) empirically examine determinants of voluntary disclosures of oil and gas reserves. They show that within an environment of complete voluntary disclosure, most firms do not comply with the SORP and operating and financial review (OFR). They attribute the non-compliance to increased political and propriety costs rather than agency benefits, choosing non-disclosure or lower-level disclosure.

The impact of reserves disclosure on the market value of reporting firms, established in the case of mandatory disclosure, results from the valuation of a firm's market value through the firm's reserve quantum (McChlery et al., 2015). Oil and gas reserves are the sources of revenue for oil and gas companies and are the most important tangible economic asset; they source future cash flows from sales and furnish information to borrow and raise equity (PWC, 2011). Therefore, reporting reserve quantities signals the availability of revenue to the market, thereby enhancing the market value of reporting entities. The higher the reserve quantity, the higher the market value of the reporting entity.

Abdel-Azim and Abdelmoniem (2015) investigate the effect of voluntary disclosure and risk management on firm value using a sample of firms from the Egyptian stock exchange in 2012. Accordingly, Abdel-Azim and Abdelmoniem (2015) reported that voluntary disclosure positively relates to firm value, given that increased disclosures induce risk exposure reduction, which impact firm value positively. Banghøj and Plenborg (2008) establish that voluntary disclosures do not provide the kind of information easily interpreted by investors to predict future earnings. Moreover, Abdo et al. (2017) indicate that such disclosures are challenging to understand by non-finance-background investors. Additionally, Aboody (1996) argues that good-news type

[4] Proved reserves are the quantities of petroleum approximated with a reasonable level of certainty via the analyses of engineering and geological data, recoverable commercially from a specific date from reservoirs known and under current operating techniques, government regulations, and economic conditions. See http://www.spe.org/industry/petroleum-reserves-definitions.php.

disclosures may not always lead to increased firm's value if investors fail to understand and recognise the financial underpinnings of such disclosures. Thus, although the information provided as a sort of voluntary disclosures may be skewed towards positivity, some of it may be confusing to investors and may not assist them in predicting the future value of the company.

Lys (1986) investigated the relationship between the values of oil and gas reserves and firm's value. They regressed the annual change in the value of the firm against that in the value of oil and gas reserves. The results demonstrate a significant variation from zero but considerable deviation from theoretical values, supporting the assumption that a relationship exists between implicit disclosures (recognition accounting) and the perception of investors on firm (market) value.

Disclosure of decommissioning costs

Owing to their nature and cash outflow effects disclosures of decommissioning costs of oil and gas installations can decrease firm value and performance. Significant future cash outflows come with decommissioning (see PWC 2011; Rogers and Atkins 2015). Unlike the US case where firms must set up a decommissioning fund (PWC 2011), Aldersey-Williams and McKenna (2016) highlight that no regulation requires oil and gas firms to have sinking funds or cash set aside for decommissioning in the UK; thus, if companies do not set aside funds for decommissioning, they will have to either use their profits or to obtain loans to fund the high cost of decommissioning.

Russell et al. (1998) review accounting for the abandonment of the oil and gas structure in the UK North Sea. They use questionnaires administered among finance directors of major oil and gas companies and representatives of an accountancy firm. Data on disclosures of abandonment costs were obtained from the analyses of surveyed company accounts between 1987 and 1993. Russell et al. (1998) concluded that companies complied with the recommendations of the SORP; however, disclosures lacked details and clarity.

Alciatore and Callaway Dee (2006) show that among US oil and gas firms, although most firms stated that they accrued costs of environmental exit and remediation liabilities, less than half disclosed the value of accrual. Rogers and Atkins (2015) evaluate US oil and gas decommissioning liabilities within the environmental disclosure report framework. They concluded that the actual performance of oil and gas companies regarding the comparability across firms and reporting periods, accuracy of estimates, funding, and forecasting are poor.

Abdo and Mangena (2018) and Abdo et al. (2018) investigate compliance with requirements for accounting disclosure relates to decommissioning cost provisions by oil and gas companies. Further, they assess the perception of stakeholders about company reporting practices. They report a high compliance level with fewer disclosures requirements. Abdo and Mangena (2018) report that oil and gas companies provide numerical disclosure in most cases on the decommissioning cost provisions without providing detailed narrative explanations.

Abdo et al. (2017) study compliance, sufficiency, uniformity, and fairness of oil and gas companies' disclosure practices regarding provisions for decommissioning costs in the UK. They focused on the UK to explore the usefulness and success of International Accounting Standards (IAS) and the SORP in providing a proper principle for decommissioning costs and the level of compliance of oil and gas firms listed in the UK. Accordingly, the level of compliance with the decommissioning disclosure requirements differs; most of the sampled companies apply SORP disclosure requirements, though IAS requirements differ in focus and compliance per listed oil and gas company in the LSE. Surprisingly, oil and gas companies provide the least decommissioning disclosures, including obligations, provisions, and expenditures. Abdo et al. (2017) highlight the information to be disclosed by oil and gas companies regarding decommissioning obligations, which concern timing, amount, changes to decommissioning estimates and the reasons for such changes, cash outflow timing, and discount rate used. Moreover, a breakdown of such obligations into geographical areas and individual fields is necessary. However, despite the number of studies on decommissioning related to disclosures, none addresses the impact of disclosures on reporting companies' market values and performance. This study bridges the gap.

Measuring the level of disclosure

Given the non-existence of a suitable model, measuring the level of disclosures or disclosure quality is challenging. Further, there are no reliable and relevant measurement techniques (Eng and Mak 2003) and a sufficient degree of accuracy (Beattie et al. 2004) to measure the quality of disclosures. Productive disclosures in any field bear the following essential characteristics: they are consistent throughout their respective industries; can be compared, allowing investors to analyse peers and weigh risks; have genuine, reliable data; have digestible information that is clear and well defined; and are efficient in that they minimise costs and maximise returns (Hassan and Marston, 2019).

Some studies (e.g., Firth 1980; Botosan 1997; Hooks et al. 2012) use weighted indices for their relative importance. However, other studies use un-weighted indices (e.g., Cooke 1989; Hossain et al. 1994; Owusu-Ansah 1998; Abdo 2016; Abdo et al. 2018). Un-weighted indices assume all items selected in an index are equally important, where

1 means the company discloses an item and 0 otherwise. This scoring method is known as the 'dichotomous' method, where the total score obtained by the company is related to the maximum number of items applicable for that company. The weighted indices method assumes each item in the index has different categories of importance and is weighted accordingly (Abdo et al. 2017, 2018). Crucially, choosing between these methods does not significantly change the research results (Cooke 1989).

There seems to be an open debate in disclosure studies on the measurement of disclosure quality and whether the quantity of disclosure is the proper proxy for disclosure quality. However, we follow prior studies on constructing a disclosure index (Amir and Lev 1996; Botosan 1997; Hussainey et al. 2003; Schleicher et al. 2007; Cerbioni and Parbonetti 2007; Beest et al. 2009; Hussainey and Walker 2009; Chakroun and Hussainey 2014; Alotaibi and Hussainey 2016). We extend the prior literature on measuring disclosure in the oil and gas industry (Craswell and Taylor 1992; Russell et al. 1998; Mirza and Zimmer 2001; Taylor et al. 2012; Ani et al. 2015; McChlery et al. 2015; Rogers and Atkins 2015; Odo et al. 2016; Abdo et al. 2017, 2018; Abdo and Mangena 2018). This study employs disclosure index to measure the level of mandatory and voluntary disclosures of both a) oil and gas reserves, and b) decommissioning costs of upstream exploration and production oil and gas companies listed on the LSE. Furthermore, the study aims to measure the impacts of mandatory and voluntary reserves and decommissioning disclosure made in the annual reports and accounts of upstream exploration and production oil and gas companies listed on the LSE on the value and performance of these companies.

Theoretical framework

Agency and Signalling theories assert that companies disclose information to reduce information asymmetries with existing stakeholders and potential investors in the market (Jensen and Meckling 1976; Hughes 1986). Signalling theory explains why firms disclose information to their stakeholders and how disclosures may impact stakeholder reactions and perception of the reporting entity. It considers disclosure as a signal to investors, which affects their perception of firm value and share price. According to Spence (1974), signalling theory explains how individuals who possess superior information communicate such information to others via signals. Watson et al. (2002) argue that signalling involves the agent (management) conveying meaningful information it possesses about a firm to the principal (shareholders), given management's involvement in the running of the firm. However, Toms (2002) posits that managers develop a signalling incentive only when disclosure induces high returns. Thus, irrespective of the pressure level on management, when disclosure induces sanctions by stakeholders, management chooses to disclose as minimal as possible or not to disclose. Further, signalling theory emphasises that disclosures are signals to the stock exchange about firm performance, stimulating share investments, increasing shares liquidity, and lowering capital cost (Lambert et al. 2007; Cuadrado-Ballesteros et al. 2016). Thus, failure to disclose or withhold information can signal investors to decrease their evaluation of the shares price of the company (Abdo et al. 2018).

Agency theory is extensively employed in accounting arguments to explain managers' motivation for disclosures (Lim et al. 2007). The need for disclosure stems from agency problems between internal and external parties to a corporation. According to the theory, the principal delegates powers to the agent to make decisions, thus managing the firm and performing services on the principal's behalf (see Jensen and Mecing, 1976; Eisenhardt 1989; Healy and Palepu 2001; Shapiro 2005; Cotter et al. 2011, 2012). Allegrini and Greco (2013) and Salehi et al. (2017) highlight those greater levels of voluntary disclosure are expected from firms whose corporate governance practices have intensive monitoring, thereby reducing the opportunistic behaviour of managers and information asymmetry. Hence, managers operating within such an environment are less likely to withhold information for private benefit, and there is enhanced quality and comprehensiveness of disclosure (Allegrini and Greco 2013). Thus, agency theory can explain the relationship between disclosure, value, and performance.

Management (the agent) is legally and ethically required to provide shareholders (the principal) and wider stakeholders groups with sufficient information to allow sensible decision-making (Healy and Palepu 2001; Brammer and Pavelin 2008; Oluwagbemiga 2014). Thus, reserves and decommissioning-related disclosures in the oil and gas industry reduce agency-related costs between managers and investors; help investors evaluate company performance and improve their ability to assess managerial performance (Abdul et al., 2018).

From the two companion theories, assumptions of reduced agency cost and information asymmetry via the increased level of disclosures are relevant to disclosure of oil and gas reserves as signals of good news and decommissioning costs and obligations as likely signals of bad news or environmental responsibility. However, both types of disclosures are key for informed decisions to evaluate future financial performance and values of oil and gas companies.

Research design

This study employs a two-stage research approach to address the research questions. In the first stage, we construct a reserve and decommissioning disclosure index (R&DDI) to evaluate the disclosure types and levels for *mandatory* and *voluntary* oil and gas reserves and decommissioning cost-related disclosures. The index is used to record the disclosure level of oil and gas companies listed on the LSE for

Table 1 Performance and value variables

Variable name	Measure	Definition and explanation
ROA	Return on Assets	Net income over total assets in a fiscal year
ROE	Return on Equity	Net income available for common shareholders over average total equity; average equity denotes the average equity during a fiscal year
OCF	Operational Cash flow	Rank logarithm of the total amount of cash a company generates from its operation
PROFITS	Net income, also known as after-tax profits	Profit of the firm after tax deductions
Tobin's Q	Ratio of the firm's value	Ratio of the market value of a firm to the replacement cost of the firm's assets
EBITDA	Value based on earnings before interest tax, depreciation, and amortisation	Rank logarithm of operating profits before the deduction of non-cash items, depreciation, and amortisation
Price	Reflects company value as evaluated by the shareholders in the market	The last price based on the exchange data that reflects company value as evaluated by the shareholders
MV	Value of the company compared to its market value	Market capitalisation is the number of shares outstanding times the share price

10 years from 2010 to 2019. The R&DDI[5] is divided into four sections, it includes six items are mandatory requirements for reserve disclosures, and six items are mandatory decommissioning disclosures; these items are extracted from IAS and International Financial Reporting Standards (IFRS) mandatory disclosure requirements. Further eight items capture the voluntary disclosure requirements for reserves, and seven items capture the volumetry disclosure requirements for decommissioning costs. Decommissioning disclosures are extracted from SORP and SEC requirements for best practices in the upstream oil and gas industry.

The sampled comprises are active upstream oil and gas producers listed on the Main and AIM markets on LSE. London's financial centre offers easy access to capital market expertise and is a magnet for foreign listings (Yeandle 2018). Similarly, Luther (1996, p. 82) stated: '[The LSE] is the most important foreign source of equity finance for [extractive industry (EI)] companies worldwide; some 200 [EI] companies are listed'. Thus, this study focuses on the upstream oil and gas companies listed on the LSE. As of July 2020, 111 oil and gas companies were listed on the LSE, 31 in the main market and 80 in the AIM. This study excluded any non-upstream oil and gas companies or firms not in the production stage. This criterion leaves us with 52 firms.

Annual reports and accounts of the 52 companies were downloaded from their websites. We read and scanned through these annual reports and accounts and hand-picked related disclosures. We constructed R&DDI based on these manually and digitally collected data. In constructing the disclosure index, we follow the binary coding system where 1 means present and 0 otherwise (Beattie et al. 2004).

[5] The R&DDI is the constructed reserve and decommissioning disclosure index of 27 items (see the Appendix).

This study employs two techniques for constructing the disclosure index (NVivo software and manually) to identify major themes within disclosure items from annual reports of the sampled companies and develop the required company scores. The NVivo findings are reviewed manually to identify shortcomings or faults. We first coded the main study items: mandatory and voluntary disclosure items of reserve and decommissioning. Each annual report and accounts were scanned via NVivo before coding to search for disclosures items. Some terms, such as reservoir for reserves and abandonment and assets write down for decommissioning, were incorporated as alternative terminologies to determine the same category in the disclosure index and decide on the relevance of an item to develop the disclosure index. We then coded all developed disclosure index items to measure and score the different disclosures as independent variables in the econometric model.

Quantitative data on firms' performance and value (dependent variables) and institutional ownership, leverage, size, auditor quality, listing state, accounting method, firm age, and the environmental, social, and governance (ESG) index score (control variables) were obtained from the annual reports and accounts and data providers such as the LSE and Bloomberg terminal to account for firms' characteristics. Tables 1 and 2 define the study variables.

Following a linear regression by prior studies (Craswell and Taylor 1992; Mirza and Zimmer 2001; Taylor et al. 2012; Ani et al. 2015; McChlery et al., 2015; Odo et al., 2016), we constructed a models that estimates the relationships between the different reserve and decommissioning disclosure types and various performance and value variables for the sampled firms. Rank log is applied to some of the variable data sets. We rank the values and take their logarithm to improve interpretability and visualisations for analysis. This method also addresses the issue of skewness

Table 2 Independent and control variables

Variable name	Measure	Definition and explanation
DisMRQ (independent)	Level of mandatory reserve disclosure	The total number of points given for mandatory disclosure of reserves by disclosure index (Table 9), coded 1 if disclosed or 0 if not disclosed
DisVRQ (independent)	Level of voluntary reserve disclosure	Total number of points awarded for voluntary disclosure of reserves by disclosure index (Table 9), coded 1 if disclosed or 0 if not disclosed
DisMDQ (independent)	Level of mandatory decommissioning disclosure	Total number of points awarded for mandatory disclosure of decommissioning by disclosure index (Table 9), coded 1 if disclosed or 0 if not disclosed
DisVDQ (independent)	Level of voluntary decommissioning disclosure	Total number of points awarded for voluntary disclosure of decommissioning by disclosure index (Table 9), coded 1 if disclosed or 0 if not disclosed
Govern (control)	Institutional ownership	The ratio of ordinary shares owned by financial institutions; institutions with equity of 5% or more take 1 and 0 otherwise
Leverage (control)	Percentage of the total debt relative to total assets	Total debt divided by total assets
Size (control)	Total assets	Rank logarithm of year-end total assets
Auditor (control)	Auditor quality	Coded as 1 if the auditor is a big-four firm and 0 otherwise
Listing State (control)	Firms listing in main market or AIM market	Coded as 1 if listing is in the main market or 0, the AIM market
Firm age (control)	Number of years firm has been listed	The total number of years listed in the market
Accounting method (control)	The rules a company follows in reporting revenues and expenses	The three primary methods are accrual accounting, cash accounting, and a hybrid of the two; the methods included here, however, are only the first two
(ESG) index score	Environmental, social, and governance (ESG) criteria are a set of standards for company operations that socially conscious investors use to screen potential investments; Governance addresses a company's leadership, executive pay, audits, internal controls, and shareholder rights; The ESG value ranges from 0.1 to 100	Used to measure the sustainability and ethical impacts of an investment within a company

to large values and displaying percentage change and multiplicative factors. The models measuring the impact of firm performance and value are as follows:

$$\begin{aligned}&\text{PerformanceandValue}\\&=\alpha_0+\alpha_1 DisMRQ_{i,t}+\alpha_2 DisVRQ_{i,t}+\alpha_3 DisMDQ_{i,t}\\&\quad+\alpha_4 DisVDQ_{i,t}+\alpha_5 Govern_{i,t}+\alpha_6 Leverage_{i,t}\\&\quad+\alpha_7 Size_{i,t}+\alpha_8 Auditor_{i,t}+\alpha_9 FirmAge\varepsilon_{i,t}\\&\quad+\alpha_{10} AccMethod_{i,t}+\alpha_{11} Listing_{i,t}+\alpha_{12} ESG+\varepsilon_{i,t}\end{aligned}$$

Data

Disclosure index

The study classifies disclosures into four categories: mandatory reserve, voluntary reserve, mandatory decommissioning, and voluntary decommissioning disclosures. We then construct a disclosure index and use content analysis to determine the level of each of the four disclosure categories.

Reliability tests

A data reliability test was conducted for disclosure constructs to test for the construct reliability. This was undertaken by generating Cronbach's alpha values for the respective items used to measure the different constructs of reserve and decommissioning disclosure levels. As per Carney's (2020) criteria for considering disclosures, the most productive disclosures in any field bear the features of consistency, comparability, reliability of data, information that is digestible and well defined, and efficiency. Table 3 reports the reliability statistics for the various constructs.

From the reliability statistics results in Table 3, the respective Cronbach's alpha values are greater than the minimum alpha coefficient of $\alpha = 0.65$ (Creswell 2014), indicating strong internal consistency among the items

Table 3 Cronbach's alpha for decommissioning and reserve disclosure

Variable	Number of items in the scale	Cronbach's Alpha
Mandatory decommissioning disclosure	6	0.9463
Mandatory reserve disclosure	6	0.8911
Voluntary decommissioning disclosure	7	0.9492
Voluntary reserve disclosure	8	0.9282

used to measure decommissioning and reserve disclosure of listed oil and gas companies. Moreover, an intercoder reliability test was performed to ensure the reliability of the research findings by comparing correlations between automated- and manual-disclosure constructs. Table 4 shows that the correlation between manual and automated constructs of mandatory reserve (r = 0.994**), voluntary reserve (r = 0.994**), mandatory decommissioning (r = 0.990**), and voluntary decommissioning (r = 0.987**) disclosures were high, confirming the reliability of the disclosure constructs.

Validity tests

Convergent validity tests were conducted for the constructed R&DDI using Pearson correlation tests. High intercorrelations between items implies that the items are related or move together when exposed to a particular construct. Measurement items for the mandatory reserve, voluntary reserve, mandatory decommissioning costs, and voluntary decommissioning costs disclosures were correlated (Table 5). All the measurement items for the various constructs exhibit significant and high correlations ($p < 0.05$), which suggest convergent validity in the four disclosure constructs.

Empirical results

Correlation analysis

Table 6 presents the results of the correlation analysis between the independent and control variables under consideration. Positive (negative) coefficients imply a positive (negative) relationship between the variables under consideration.

A strong and statistically significant relationship exists between disclosures and company characteristics. For instance, mandatory reserve (r = 0.408), voluntary reserve (r = 0.364); mandatory decommissioning (r = 0.409); and voluntary decommissioning (r = 0.421) disclosures and company age exhibit a strong and positive relationship.

Descriptive analysis

From Table 7, the variation from the mean for the independent variables differed extensively. For instance, DisVDO (M = 2.28, SD = 2.09), DisMRO (M = 4.45, SD = 2.044), DisMDO (M = 3.6, SD = 2.167), DisVRO (M = 3.69, SD = 2.824), and Listing Status (M = 0.29, SD = 0.453) have data sets clustered around the mean. The remaining variables have data sets spread out.

Regression analysis

This study uses the Ordinary Least Square (OLS) longitudinal panel regression with robust standard error being employed. The robust standard error option is applied in order to adjust the OLS parametric test to fit with non-parametric data. Multiple regression analysis using OLS is undertaken to examine the relationship between level of disclosure (mandatory and voluntary) of reserves and decommissioning with four *dependent performance* variables and with four *dependent value* variables of LSE listed upstream exploration and production oil and gas firms. This allows for establishing the variable coefficients (β) that are influential in predicting the categorical outcome

Table 4 Correlation between automated- and manual-disclosure constructs

Item	Manual
Mandatory reserve disclosure	
Manual	–
Automated	.994**
Voluntary reserve disclosure	
Manual	–
Automated	.994**
Mandatory decommissioning disclosure	
Manual	–
Automated	.990**
Voluntary decommissioning disclosure	
Manual	–
Automated	.987**

** r is high and close = 1

Table 5 Correlation among measurement items for various constructs

Items	1	2	3	4	5	6	7
Mandatory reserve disclosure items							
1. DisMRQ1	–						
2. DisMRQ2	.832**	–					
3. DisMRQ3	.703**	.798**	–				
4. DisMRQ4	.641**	.694**	.852**	–			
5. DisMRQ5	.508**	.546**	.689**	.763**	–		
6. DisMRQ6	.519**	.556**	.581**	.577**	.626**		
Mandatory decommissioning disclosure items							
1. DisMDQ1	–						
2. DisMDQ2	.766**	–					
3. DisMDQ3	.670**	.568**	–				
4. DisMDQ4	.693**	.741**	.572**	–			
5. DisMDQ5	.636**	.717**	.484**	.706**	–		
6. DisMDQ6	.443**	.431**	.473**	.392**	.525**		
Voluntary decommissioning disclosure items							
1. DisVDQ1	–						
2. DisVDQ2	.348**	–					
3. DisVDQ3	.464**	.583**	–				
4. DisVDQ4	.268**	.080	.376**	–			
5. DisVDQ5	.434**	.582**	.714**	.296**	–		
6. DisVDQ6	.294**	.135**	.205**	.388**	.202**	–	
7. DisVDQ7	.245**	.267**	.173**	.399**	.137**	.402**	
Voluntary reserve disclosure items							
1. DisVRQ1	–						
2. DisVRQ2	.536**	–					
3. DisVRQ3	.655**	.517**	–				
4. DisVRQ4	.699**	.710**	.538**	–			
5. DisVRQ5	.286**	.284**	.324**	.218**	–		
6. DisVRQ6	.304**	.288**	.389**	.231**	.523**	–	
7. DisVRQ7	.579**	.456**	.616**	.490**	.246**	.406**	–
8. DisVRQ8	.683**	.529**	.773**	.522**	.351**	.404**	.653**

**$p < .01$. *$p < .05$

and understanding the strength and significance of different independent variables in influencing the probability and likelihood of such disclosures. Table 8 reports the regression results.

Discussion

Impact of mandatory reserve disclosures on firm performance and value

This study posited that disclosures of reserves quantities and values paint a positive impression of anticipated future cash flows in the market, impacting firm performance and value positively.

Relationship between mandatory reserve disclosures and firm performance

From Table 8, the coefficients of mandatory reserve disclosure for return on assets (ROA) ($\beta = -0.778, p < 0.05$), return on equity (ROE) ($\beta = -1.189, p < 0.05$), and earnings before interest, taxes, depreciation, and amortisation (EBITDA) ($\beta = -8.828, p < 0.05$) are negative and statistically significant. Therefore, a negative relationship exists between *mandatory reserve* disclosure and firm performance. Dye (1990) posits that mandatory disclosure may affect investor perceptions of a company's competitors, thereby influencing their beliefs on the company's future prospects and likely inducing real or financial externalities. Moreover, Craswell and Taylor (1992) suggest that the

Table 6 Correlation table

Variables	DisMRO	DisVRO	DisMDO	DisVDO	Size	Leverage	Audit	Firm Age	Accounting Method	Listing Status	ESG
DisMRO	1										
DisVRO	0.279***	1									
DisMDO	0.268***	0.271***	1								
DisVDO	0.238**	0.282***	0.213***	1							
Size	0.197*	0.161*	0.283***	0.523***	1						
Leverage	0.0728	0.0850	−0.0141	−0.0363	−0.0593	1					
Audit	0.0181	0.163*	0.151	0.0815	0.186*	0.287***	1				
Firm Age	0.408***	0.364***	0.409***	0.421***	0.526***	0.0598	0.140	1			
Accounting Method	0.0126	−0.0770	0.0740	−0.0621	−0.239**	0.0170	−0.473**	−0.206*	1		
Listing Status	0.138	0.336***	0.222**	0.109	0.0221	−0.0721	0.0517	0.431***	−0.371***	1	
ESG	0.292***	0.141	0.192*	0.314***	0.566***	0.0686	0.310***	0.641***	−0.508***	0.128	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, representing 10%, 1%, and 0.01% significance levels

reserve disclosure may not be as significant for explorer firms because they may not have substantial reserves to disclose. Thus, the negative relation might refer to a low-quality disclosure level or having no substantial reserves to discloses made by a given firm.

Relationship between mandatory reserve disclosure and firm value

A positive and statistically significant relationship exists between *mandatory reserve* disclosure and the price as an indicator of company value. The coefficients of mandatory reserve disclosure for price is ($\beta = 1.542, p < 0.01$), where the announcement of new oil and gas discoveries sends future revenue and cash inflow signals to the market, which enhances investors' expectations of future performance of the reporting entity, enhancing its market value. McChlery et al. (2015) explain that the impact of reserves disclosure on market value stems from the valuation of an entity's market value through its reserve quantum. Accordingly, oil and gas reserves are the main sources of revenue for exploration and production oil and gas companies, and are the most important tangible assets for these companies. Reporting reserve quantities by listed oil and gas companies, therefore, serves as a key market indicator on revenue generation, thereby enhancing the market value of reporting companies.

Our results accord with Aboody (1996), who establish that reserve disclosure significantly impacts the value of oil and gas firms. Similarly, Patatoukas et al. (2015) posit that there is value relevance in the mandatory disclosure of the discounted cash flow of reserves.

Impact of mandatory decommissioning disclosure on performance and value

Relationship between mandatory decommissioning disclosures and performance

The coefficients of mandatory decommissioning disclosure for ROA ($\beta = 0.806, p < 0.05$) and ROE ($\beta = 0.861, p < 0.05$) are positively and statistically significant (Table 8). Thus, a positive relationship exists between mandatory decommissioning disclosure and the performance of listed oil and gas companies in the UK.

The positive relationship may stem from the fact that decommissioning disclosure is unfavourable information (Abdo et al. 2018); however, oil and gas firms have incentives to provide more details about the decommissioning provision or process reduce the probability of being considered 'a lemon' by investors (Akerlof 1970). If a firm does not provide disclosures, this might be seen as withholding negative information, which could drive investors to lower the market value of the

Table 7 Descriptive statistics for the independent variables

	N	Minimum	Maximum	Mean	Standard deviation	Variance
DisMRO	520	0	6	4.45	2.044	4.179
DisVDO	520	0	7	2.28	2.09	4.37
DisMDO	520	0	6	3.6	2.167	4.694
DisVRO	520	0	8	3.69	2.824	7.973
Size	502	0.082099	333151.1	9223.372	9223.372	$2.50E+09$
Leverage	501	0	135.8349	14.52341	18.96945	359.84
Audit	520	0	1	0.58	0.493	0.243
FirmAge	520	0	65	10.28	11.043	121.958
ListingStatus	520	0	1	0.29	0.453	0.205
ESG	152	9	71	38.4	18.906	357.434
ROA	489	−278.1	64.8	−9.131	25.3707	643.672
ROE	474	−468	120	−12.33	40.126	1610.062
OCF	498	−124.203	9223.372	1167.367	4638.628	21516867
TobinQ	471	0	56	1.49	3.028	9.168
EBITDA	480	−1150	40480	1411.89	5854.298	34272801
Profits	498	−4242.55	9223.372	445.9526	2329.902	5428441
Price	482	0	151	4.81	13.69	187.418
MBV	470	−26	52	1.73	4.685	21.953

Table 8 Impact of disclosure on performance and value

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ROA	ROE	OCF	TobinQ	EBITDA	Profits	Price	MBV
DisMRO	−0.778*	−1.189*	59.58	−0.0522	−8.828*	−99.89	1.542**	−0.115
	(−2.06)	(−2.15)	(0.44)	(−1.36)	(−2.04)	(−0.73)	(2.68)	(−1.89)
DisVRO	−1.656*	−2.814*	−229.0	−0.102*	−433.8*	−284.1	−1.750**	−0.137*
	(−2.08)	(−2.19)	(−1.58)	(−2.46)	(−1.98)	(−1.91)	(−2.83)	(−2.10)
DisMDO	0.806*	0.861*	282.6	0.0435	527.9	222.9	4.602***	0.0964
	(2.10)	(2.14)	(1.48)	(0.80)	(1.83)	(1.14)	(5.63)	(1.12)
DisVDO	0.122*	0.262	−224.1	−0.0631*	−431.7	−125.7	−4.981***	−0.182*
	(2.03)	(0.13)	(−1.12)	(−2.11)	(−1.43)	(−0.61)	(−5.83)	(−2.02)
Size	0.0000191	0.0000583	0.0900***	0.00000105	0.111***	0.0401***	0.000115***	0.00000213
	(0.92)	(1.50)	(23.92)	(0.98)	(19.45)	(10.39)	(7.17)	(1.25)
Leverage	−0.137*	−0.232*	0.741	0.00126	−0.795	−6.280	0.0557	0.00249
	(−2.26)	(−1.98)	(0.07)	(0.40)	(−0.05)	(−0.56)	(1.17)	(0.50)
Audit	−0.719	−0.922	357.5	−0.105	535.4	342.7	8.760***	−0.158
	(−0.26)	(−0.18)	(0.70)	(−0.72)	(0.69)	(0.65)	(4.01)	(−0.68)
Firm age	0.148	0.146	−34.55	0.0127*	−52.33	−31.89	−0.00872	0.0228*
	(1.32)	(0.68)	(−1.69)	(2.16)	(−1.69)	(−1.52)	(−0.10)	(2.45)
Accounting Method	−2.443	−2.555	−159.1	0.00734	−225.8	−120.1	3.019	0.105
	(−0.88)	(−0.48)	(−0.31)	(0.05)	(−0.29)	(−0.23)	(1.34)	(0.44)
Listing Status	−0.407	2.910	139.0	−0.382*	482.8	228.2	−6.791**	−0.866**
	(−0.13)	(0.49)	(0.24)	(−2.29)	(0.56)	(0.39)	(−2.72)	(−3.27)
ESG	−0.0304	−0.00958	11.15	−0.0139*	9.282	5.944	−0.236**	−0.0190*
	(−0.29)	(−0.05)	(0.60)	(−2.51)	(0.33)	(0.31)	(−2.85)	(−2.17)
Constant	13.54	16.55	566.8	2.553***	1553.6	1472.6	3.653	3.497***
	(1.39)	(0.88)	(0.32)	(4.81)	(0.58)	(0.81)	(0.46)	(4.15)
N	489	474	478	471	480	498	482	470

t statistics are in parentheses; *$p<0.05$, **$p<0.01$, ***$p<0.001$

firm (Abdo et al. 2018). However, agency theory posits that disclosures reduce manager-shareholder agency costs (Luther 1996). Therefore, decommissioning disclosures help shareholders understand firm operations and performance in that they improve shareholders' ability to observe managers' attitude, behaviour, and performance (Abdo et al. 2018).

Relationship between mandatory decommissioning disclosure and firm value

A positive and statistically significant relationship ($\beta = 4.602, p < 0.01$) exists between *mandatory decommissioning* disclosure and Price as the indicator variable of the value of listed oil and gas companies in the UK. Regarding this relationship, signalling (Hughes, 1986) and agency (Jensen and Meckling, 1976) theories argue information disclosure reduces information asymmetries. Signalling theory underlines those disclosures signal firm quality to the market. The disclosures level encourages investors and improves liquidity, as reflected in lowering the cost of capital (Cuadrado-Ballesteros et al. 2016). Even though decommissioning disclosure is unfavourable (Abdo et al. 2018), reporting decommissioning obligations signals that the company can financially undertake costly decommissioning operations. This perspective assures investors of the company's financial strength and balances, thus enhancing its market value.

Impact of voluntary reserve disclosures on firm performance and value

Relationship between voluntary reserve disclosure and firm performance

A negative and statistically significant relationship exists between the level of *voluntary oil and gas reserve* disclosures and the performance of oil and gas companies listed on the LSE. The coefficient of voluntary reserve disclosure for the ROA ($\beta = -1.656, p < 0.05$), ROE ($\beta = -2.814, p < 0.05$) and EBITDA ($\beta = -433.8, p < 0.05$) is negative and statistically significant (Table 8). Insufficient voluntary reserve disclosures and a firm's unwillingness to disclose more information about its oil and gas reserves, such as risks regarding proved or developing reserves, explain the results, which raises questions about the efficacy of voluntary requirements of firms that do not provide enough information in their annual reports. McChlery et al. (2015, p. 5931) report that 'oil and gas reserves disclosures are subject to inherent risk and uncertainty'. The finding also accords with Craswell and Taylor (1992), where most managers in oil and gas companies are eager to maintain voluntary disclosures.

Relationship between voluntary reserve disclosure and firm value

A negative and statistically significant relationship exists between *voluntary reserve* disclosures and the value of listed oil and gas companies in the UK. The coefficient of voluntary reserve disclosure for TobinQ ($\beta = -0.102, p < 0.05$), price ($\beta = -1.750, p < 0.01$) and market value ($\beta = -0.137, p < 0.05$) is negative and statistically significant (Table 8). According to the signalling theory, good or bad performance can impact share prices and, hence, a company's market value. However, given their cash inflow effects, disclosures of reserves offer signals which impact the value of reporting oil and gas companies.

Aboody (1996) confirms that production level affects the extent to which oil and gas firms provide voluntary disclosures. Similarly, Taylor et al. (2012) report that even when oil and gas firms provide information about proved and developed reserves, more data on future performance factors, reserve risks, and governance are needed in the annual report, which affects investors' evaluation of firm value.

Impact of voluntary decommissioning disclosures on performance and value

Relationship between voluntary decommissioning disclosure and performance

A positive and statistically significant relationship exists between *voluntary decommissioning* disclosure and ROA ($\beta = 0.122, p < 0.05$); moreover, it exhibits a positive but not significant relation with ROE (Table 8). The findings accord with Hapsoro and Ambarwati (2018), where disclosure on carbon emission (an environmental concern, as in decommissioning) among oil and gas firms positively impacts ROA. It also accords with Ayodele et al. (2016), who find a positive relationship between corporate governance disclosures (comparable to the environmental concept) and ROA.

Considering agency theory, given the role of disclosure in reducing estimation risk, information asymmetry, and adverse selection costs reducing, Abdo et al. (2017, 2018) note that firms provide limited information about decommissioning costs, thereby contributing to information asymmetry.

Relationship between voluntary decommissioning disclosure and firm value

A negative and statistically significant relationship exists between *voluntary decommissioning* disclosures and the value of listed oil and gas companies. The voluntary decommissioning disclosure coefficient for TobinQ

($\beta = -0.0631, p < 0.05$), price ($\beta = -4.981, p < 0.001$), and market value ($\beta = -0.182, p < 0.05$) are negative and statistically significant (Table 8).

Oil and gas firms may have incentives to provide more details about the decommissioning provision or process to reduce the probability of being considered 'a lemon' by investors (Akerlof 1970). Signalling theory posits that firm performance can drive share prices and market value. Moreover, disclosure can impact firm value, where good news provides positive signals regarding cash flow and profitability. However, bad news signals reduced profitability and cash outflows, which negatively impact the value of a firm. The bad news signal seems to be the case here. Rogers and Atkins (2015) report that the performance of oil and gas companies relative to firms in other industries was extremely poor in reporting periods, accuracy of estimates, funding, and forecasting. Their findings complement Standard and Poor (2007), who also find that firms give the least possible amount of information in reporting decommissioning obligations (see also Abdo et al. 2018).

Conclusion

This study addresses the impact of reserve and decommissioning disclosures on the value and performance of oil and gas companies listed in the UK. The literature shows a strong relationship between disclosure and firm value and performance. Furthermore, a firm's disclosure quality and quantity are motivated by specific firm characteristics. We constructed a R&DDI. This index accounts for cash inflow and outflow drivers of two key investment indicators of the oil and gas industry: oil and gas reserves and decommissioning expenditure. Adopting our constructed index can help researchers probe disclosures of extractive and similar industries such as coal, metal, and nuclear.

A positive (negative) and statistically significant relationships exist between *mandatory* reserve disclosures and firm value (performance). *Voluntary* reserve disclosures negatively impact both firm performance and value. Furthermore, while a positive relationship exists between *mandatory decommissioning* disclosure and both performance and value, a negative (positive) and statically significant relationship exists between *voluntary decommissioning* disclosure and firm value (performance).

The results are significant as they unveil the difference in value and performance from each disclosure type, individually and collectively. They are important for industry stakeholders and investors interested in investing in the oil and gas industry. The findings are also useful for UK regulating bodies, warranting a mandate of sufficient disclosures to meet stakeholder requirements. Moreover, managers working in oil and gas companies can also appreciate the importance of disclosures and how it impacts a firm's dynamics, directly impacting stakeholder interest. Based on the study results, managers of listed upstream exploration and production oil and gas companies in the UK must focus more on voluntary reserve and decommissioning disclosure to enhance firm performance and value more effectively. This study shows that the most significant impact of reserve and decommissioning disclosures was on firm's value (Price) for both *mandatory* and *voluntary* reserve and decommissioning disclosures. Share price is normally highly sensitive to disclosures as signals of good or bad news to the investors in the market.

Although decommission and reserve mandatory and voluntary disclosures have mixed impacts on firm value and performance, firms largely disclose such information. Lack of disclosures is attributed to proprietary costs linked with competitive advantages (other companies' voluntary disclosures), increased scrutiny by the public, and misinterpretation of information.

The limitation of this study lies in the sample of 52 companies in the production stage that disclose reserves and decommissioning information. However, since companies listed on the UK stock exchange are of different sizes, nationality and investment portfolios our results can be generalised to companies from other sectors on the same market such as mining companies, and oil and gas companies and mining companies from other stock markets. Future studies may probe and ascertain whether the shift in investor focus from cash outflows to environmental damage is a concern only in the UK and Western countries where issues of corporate governance are strongest or a global phenomenon. This is particularly important since countries are legislating net zero and this may result in stranding oil and gas assets prematurely, which may bring decommissioning of oil and gas assets forward. Therefore, disclosures of oil and gas reserves and decommissioning expenditure on value and profitability of oil and gas companies seem to be of key importance to investors in this transition period to net zero.

Appendix

Disclosure index for reserves and decommissioning disclosure among listed oil and gas companies in the London Stock Exchange (See Table 9).

Table 9 Disclosure index

No	Disclosure item	Score	Notes
		Disclosed	Not disclosed
1	Mandatory reserve disclosure		
1.1	Information on proved developed reserves		
1.2	Information on proved undeveloped reserves		
1.3	Information about unproved reserves		
1.4	Information about probable reserves		
1.5	Information about possible reserves		
1.6	Explanation of change made to past hydrocarbon resource and reserve estimation, including change to underlying key assumptions		
	Total score for mandatory reserve disclosure		
2	Voluntary reserve disclosure		
2.1	Commercial oil and gas reserves at the beginning and end of each financial year		
2.2	Oil and gas reserves quantity in total and by geographical region		
2.3	Any changes and detail of movement in oil and gas reserves, including revisions of previous estimates, purchases of reserves in the place and production		
2.4	Oil and natural gas in barrels and gas reserves in cubic feet		
2.5	Disclosure of reserves from non-traditional sources (i.e. bitumen, oil sands, shale, coalbed methane) as oil and gas reserves		
2.6	The sensitivity of reserves numbers to price		
2.7	The qualifications of the technical person primarily responsible for overseeing the preparation or audit of the reserves estimates		
2.8	Company progress in converting proved undeveloped reserves into proved developed reserves		
	Total score for voluntary reserve disclosure		
3	Mandatory decommissioning (Abandonment) disclosure		
3.1	Decommissioning provisions are measured at the present value of the expected future cash flows		
3.2	The total cost of the fixed asset, including the cost of decommissioning, is depreciated on the basis that best reflects the consumption of the economic benefits of the asset, typically unit of production (UOP)		
3.3	The discount rate used is the pre-tax rate that reflects current market assessments of the time value of money		
3.4	The cost of the provision is recognised as part of the cost of the asset when in place and depreciated over the asset's useful life		
3.5	Decommissioning provisions are updated at each balance sheet date for changes in amount estimates or timing of future cash flows and changes in the discount rate		
3.6	A consistent policy should be adopted for deferred tax accounting for decommissioning liabilities and finance leases		
	Total Score for Mandatory Decommissioning Disclosure		
4	Voluntary decommissioning disclosure		
4.1	Risks and uncertainties to be considered in reaching the best provision estimate. It is recommended to discount the estimated future decommissioning costs at a pre-tax, free rate		
4.2	Decommissioning liabilities should include facilities where damages must be rectified		
4.3	Provisions should be reviewed at each balance sheet date to reflect the current best estimate of the cost at the present value		
4.4	Where there is an adjustment to the provision given a change in estimate, there should be a corresponding equal and opposite adjustment to the related decommissioning asset		
4.5	The unwinding of the discount should be included as a financial item adjacent to interest but shown separately from other interest in the profit and loss account or note		
4.6	Residual values of assets that are to be decommissioning cost at the time of establishing the decommissioning asset		
4.7	Decommissioning obligations to be broken down by geographical areas and individual field		
	Total Score for Voluntary Decommissioning Disclosure		

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