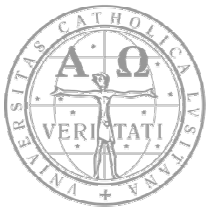

CATÓLICA LISBON
SCHOOL OF BUSINESS & ECONOMICS

UNIVERSIDADE CATÓLICA PORTUGUESA

# THE NOISE SURROUNDING THE DISCLOSURE OF OIL AND GAS RESERVES

**Liliana Filipa Rodrigues de Barros**

**150104005**

**Advisor: Ricardo Reis**

"Dissertation submitted in partial fulfillment of requirements for the degree of MSc in Business Administration, at the Universidade Católica Portuguesa, August 2012"

# Abstract

The noise surrounding the disclosure of oil and gas reserves

*Liliana Filipa Rodrigues de Barros*

The goal of this thesis is to analyze the noise surrounding the disclosure of oil and gas reserves size on the annual reports, thus it evaluates if the oil and gas companies are underestimating or overestimating their reported reserves.

Actually, this thesis also has an important role as SEC recently reviewed SFAS 69. Therefore, it addresses a currently debate about the best reporting practices of oil and gas reserves.

By analyzing the modifications made to SFAS 69, we notice that even with the modernization of rules, they still allow noise in oil and gas reserves reporting. In the oil industry, disclosed information has large implications on companies' results and the current accounting rule is not enough of an incentive for companies to report the actual reserves they own.

To study this subject, we chose a sample of 25 top oil and gas companies and analyze their oil and gas reserves reported. It demonstrated that the total oil and gas reported reserves by the 25 top companies, is smaller than the world total estimated oil and gas reserves, which means, it only match 7% of world total oil reserves and 15% of world total gas reserves. Since it is an industry that has high level of geographic concentration of resources, in other words, small number of companies in a small number of countries controls most of the oil and gas reserves, we conclude that the majority of companies is underestimating their oil and gas reserves.



## Resumo

Esta tese tem como objetivo analisar o ruído do volume das reservas de petróleo e gás publicado nos relatórios de contas anuais, logo avalia se as empresas de petróleo e gás estão a subestimar ou a sobrestimar as suas reservas publicadas.

Na realidade, esta tese desempenha também um importante papel visto que a SEC reviu recentemente a SFAS 69. Por conseguinte, foca uma discussão atual relativamente às melhores práticas de reporte das reservas de petróleo e gás.

Ao analisar as alterações feitas à SFAS 69, notamos que mesmo ao modernizarem as regras, ainda continua a ser permitido ruído no reporte das reservas de petróleo e gás. Na indústria do petróleo, a informação publicada tem grandes implicações nos resultados das empresas e as atuais regras contabilísticas não são um suficiente incentivo para que as empresas reportem as reservas que de facto possuem.

Para estudar este tema, escolhemos uma amostra de 25 empresas líderes de petróleo e gás e analisámos as suas reservas de petróleo e gás publicadas. Demonstrou-se que o total das reservas de petróleo e gás publicado pelas 25 empresas líderes é menor do que o total de reservas de petróleo e gás mundial estimado, ou seja, apenas corresponde a 7% do total de reservas de petróleo mundiais e 15% do total de reservas de gás mundiais. Uma vez que se trata de uma indústria com elevado nível de concentração geográfico, ou seja, um pequeno número de empresas em poucos países controla a maioria das reservas de petróleo e gás, concluímos que a maioria das empresas está a subestimar as suas reservas de petróleo e gás.

## TABLE OF CONTENTS:

## TABLES:

# CHAPTER 1:
# INTRODUCTION

Oil and natural gas are nonrenewable natural resources and the main world source of energy. It is probably the industry that is more closely followed in the world, as is evidenced by the attention given to the price of the oil barrel. The oil and gas industry is characterized for requiring huge investments and having a large geographic concentration of resources. This means that a small number of companies in a small number of countries controls most of the oil and gas reserves. Along with the known geo-political implications, this fact also has notorious economic implications.

In order to address some of these implications, publically listed firms in the US are bound to report the size of their reserves on the annual reports. However, we claim that these values are subject to noise. The purpose of this dissertation is to document the noise surrounding the disclosure of these reserves.

Hence, we analyze the reserve disclosures of the top oil and gas companies in the world[1]. The reporting of these reserves is regulated by accounting rules, which are enforced by the Securities and Exchange Commission (SEC). Statement of Financial Accounting Standards 69 (SFAS 69) is the accounting rule that regulates the disclosure of oil and gas reserves. SFAS 69 was originally issued in 1982 and since then it has been altered many times. The cause for this rule's evolution lies mainly on the fact that there is a lot of controversy not only surrounding disclosure requirements but also on the definitions of major concepts the rule involves and on the exact determination of oil and gas reserves. In this thesis, this controversy will be documented and the recent evolution of SFAS 69 will be described.

This dissertation also searches for evidence of the Peak Oil Theory in the reserves' disclosures of the main world oil companies. Peak oil is a theory based on the Hubbert[2] bell-shaped production curve, in which a production rate growing exponentially over time is

[1] We used Platts Top 250 Global Energy Company Rankings to select these companies. Platts is a division of McGraw-Hill Companies and is a provider of energy information well respected in the industry. (site available at http://www.platts.com/Top250Home.aspx)

[2] See Hubbert, M. K., Nuclear Energy and the Fossil Fuels 'Drilling and Production Practice', pp. 22–27, June 1956 . Available at http://www.hubbertpeak.com/hubbert/1956/1956.pdf

represented, until it reaches the maximum point, that is, until the highest rate of oil extraction is reached – the peak oil. Then, it starts to decrease, only stopping when the field is depleted. Some authors, for instance Morris Adelman[3], question the theory that states that oil reserves are running out. Yet others, for example Christophe de Margerie[4] (CEO of Total), argue that oil output is close to the peak, and claim that the recent escalade in the oil price (with the barrel reaching $143.95 on the Europe market in July 2008) can be seen as evidence that the world is running out of oil. Evidence of Peak Oil would be related to how the value of the reported reserves by the companies compares to the estimations available from several energy agencies and also to the discussion on how the reserves change from year to year. The annual variation of the reserves can be explained by the depletion caused by exploitation but also by several other dimensions, such as: adjustments, revisions (increases and decreases), sales, acquisitions, extensions, new field discoveries, new reservoir in old fields and estimated production[5]. Nevertheless, the purpose of the thesis is not prove the economic existence or not of peak oil, it is just an analysis of modifications made recently in SFAS69, describing how the rule may or may not help shed some light on where we stand with respect to increases and decreases in oil reserves.

Despite the fact that accounting rules are ever improving by trying to offer better definitions and disclosures requirements, the disclosure of oil and gas reserves still lacks verifiability. The existing rules allow for a substantial amount of noise in reserves reporting. One must notice that under U.S. standards – SFAS 69 – the reserves numbers are based on estimations, these estimates not are audited, no review of reserves estimates is required, nor are these numbers required to be prepared by an independent engineer. Canadian rules (National Instrument 51-101 Standards of Disclosure for Oil and Gas Activities), on the other hand, require a report by an independent qualified evaluator or auditor for the non-exempt companies (Schlumberger, 2003).

---

[3] See Adelman, Morris A., The Real Oil Problem. Regulation, Vol. 27, No. 1, pp. 16-21, Spring 2004. Available at SSRN: http://ssrn.com/abstract=545042, where he states: "It is commonly asked, when will the world's supply of oil be exhausted? The best one-word answer: Never"

[4] FT.com, Total says oil output near peak, By Carola Hoyos in London, Published: February 15 2009. Available at http://www.ft.com/cms/s/0/d25b8d2c-fb97-11dd-bcad-000077b07658.html?nclick_check=1

[5] See Energy Information Administration, U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2007 Annual Report, chapter 3 – Crude Oil Statistics

Finally, to conclude the goals of this thesis, using the analysis provided by the aforementioned objectives, we aim to illustrate what kind of incentives do oil and gas companies have for reporting reserves that they actually own.

Therefore, in summary, the research questions are:

1. What are the incentives of oil companies for overestimating or underestimating their reserves?
2. How does SFAS 69 allow for noise in valuation of reserves reporting?
3. How have the concepts used to estimate oil and gas reserves changed in the recent SFAS 69 review?
4. What lacks to be able to calculate the world oil and gas reserves through the sum of reserves reported by top oil and gas companies?
5. Is the new version of SFAS 69 capable of addressing some of these problems?

This thesis makes a relevant contribution, as SFAS 69 was just recently revised and the new version was effective since January 2010. Hence this study can be viewed as being part of an ongoing discussion on the best reporting practices in the topic of oil and gas reserves.

SFAS 69 deals with many controversial concepts and definitions. The recent revision triggered more than 140 comments (Release No. 33-8870; File No. S7-29-07 and Release No. 33-8935; File No. S7-15-08) from several agents in the industry contesting issues such as the definition and usage of proved reserves, proved developed reserves, producing reserves, non-producing reserves, proved undeveloped reserves, unproved reserves, probable reserves, possible reserves, among many other concepts, to name a few. The informational implications of the different definitions, as viewed in the different comments, are documented here and certainly constitute an original and relevant contribution to the accounting literature. The most relevant information provided by the companies, in accordance with this rule, is related to the proved oil and gas reserve quantities and to the capitalized costs associated with oil and gas producing activities. Capitalized costs represent the aggregate amount of expenditures on proved and unproved oil and gas properties and related accumulated depreciation, depletion and amortization, and valuation allowances.

Furthermore, we also aim to frame these tensions and discussions in the economic theory, namely using the Hotelling principle. This principle is based on the analysis of non-renewable resources' management. According to the Hotelling's (1931) "Economics of Exhaustible Resources"[6], in order to exploit efficiently and maximize the resource capital's present value, the equality between the percentage variation in net price per unit of time and the discount rate should be assured.

The fact that the accounting rule leaves some room for companies to misrepresent their reserves along with the possibility of the Peak Oil theory actually being true - which makes the running out of oil imminent and amplifies the problems anticipated by the Hotelling hypothesis - implies that the conditions are met and, therefore, the misrepresentation may have real economic implications and distort market equilibrium.

When analyzing the oil and gas reserves reported by 25 top companies, we suggest that companies are underestimating their oil and gas reserves since the sum of their total oil and gas reserves only represents 7% of world total oil reserves and 15% world total gas reserves. However, there is a lack of information on Middle East reserves which makes it impossible to take accurate conclusions. Hence, Middle East oil and gas companies do not provide the information of their reserves and the 25 top oil and gas companies do not separate their Middle East reserves from the others. Therefore, it is important to notice that not having available the Middle East reserves, as they represent approximately 50% of world total oil reserves and around 40% of world total gas reserves[7] (accordingly to the world total estimates in 2011), is a huge barrier to this analysis, which undermines any rigorous conclusion.

The organization of the thesis is as follows. In the next chapter, the concepts used and the rule which defines requirement disclosure in reporting oil and gas are explained. In addition to that, the Hotelling Principle is also described and as well as how to determine the valuation of oil and gas reserves. Chapter 3 discusses the problems behind the information required for oil and gas companies and reflects on the update made to the current rule, which is intended to better represent the current practices followed by the industry and somehow help overcoming

[6] See Hotelling, H., The economics of exhaustible resources, Journal of Political Economy Vol. 39, No. 2, pp. 137-175, April 1931. Available at SSRN: http://www.jstor.org/stable/1822328

[7] See BP Statistical Review of World Energy, June 2012. Available at: http://www.bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2012.pdf

those problems. Chapter 4 sets out the calculation of total oil and gas reserves reported annually, by 25 top oil and gas companies across nine years, in order to compare the report with the total estimation of oil and gas reserves in the world (in volume). Chapter 5 presents the results obtained in the previous chapter by stating which incentives companies have for underestimating or overestimating their oil and gas reserves. In addition, the differences between capitalized costs and barrels times the price will be analyzed. The final chapter summarizes the analysis, presents some criticisms to the new financial accounting standards, provides some possible future consequences and identifies the scope for further topics.

# CHAPTER 2:

# LITERATURE REVIEW

## 2.1 Oil and Gas Reserves Definitions

When analyzing the industry, we notice that there are several terms used to describe oil and gas reserves. However, there is no consensus[8] about these definition across the world. Thus, depending on the term used, we have distinct volumes and prices, consequently different values of reserves.

The two most important set of definitions were developed by different organizations:

- Securities and Exchange Commission (SEC) in 1978 - these definitions[9] should be used by all publicly owned U.S. listed oil companies issuing securities, when disclosing their reserves and were designed to produce conservative reports;
- Society of Petroleum Engineers (SPE) and the World Petroleum Congresses (WPC) in 1997 - their goal was to launch a worldwide single approach[10].

There are more definitions which were established by other organizations, such as the Canadian Institute of Mining, Metallurgy and Petroleum[11] (CIM) (Schlumberger, 2003). Since most of the top oil and gas companies as defined in the Platts[12] ranking are listed in U. S. stock market, they have to follow the SEC's rules. Therefore, SEC definitions are the focal point of this study. Nevertheless, we will also pay attention to other terms which are not

[8] See SPE, Comparison of Selected Reserves and Resource Classifications and Associated Definitions, December 2005. Available at http://www.aboutoilandgas.org/industry/reserves/docs/OGR_Mapping_Final_Report.pdf

[9] Available at http://www.sec.gov/divisions/corpfin/guidance/cfactfaq.htm#P279_57537

[10] Available at http://www.spe.org/industry/reserves/docs/Petroleum_Reserves_Definitions_1997.pdf

[11] See Schlumberger, Oil and Gas Reserves Disclosure White Paper, October 2003. Available at http://www.slb.com/media/services/software/whitepaper/whitepaper_oilgasreserve.pdf

[12] Platts (2008). Available at www.platts.com/top250/index.xml

approved for use in SEC fillings but are typically used in the industry, which are detailed in table 2.1.

Firstly, we shall focus on definitions used for proved, proved developed and proved undeveloped oil and gas reserves which are in accordance with the applicable U.S. SEC regulation, Rule 4.10 of Regulation S-X.

SEC definitions of oil and gas reserves were created in 1978 and since then they have become the standard in the industry for reporting purposes. When these definitions were established, it was a time of relatively stable prices, a time with long term gas contracts and the definitions have a clear U.S. domestic mindset. It is very important to notice that oil and gas companies which follow the SEC rules are only mandated to disclose proved reserves.

Rule 4.10 of Regulation S-X defines proved oil and gas reserves as "*the estimated quantities of crude oil, natural gas, and natural gas liquids which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions, i.e. prices and costs as of the date the estimate is made. Prices include consideration of changes in existing prices provided only by contractual arrangements, but not on escalations based upon future conditions*" (Rule 4.10, 1975). As estimation of oil and gas reserves involves subjective judgments, they cannot be measured exactly and consequently are subject to revisions.

Proved reserves can be categorized as either proved developed reserves or proved undeveloped reserves. Proved developed reserves are "*those reserves that can be expected to be recovered through existing wells with existing equipment and operating methods*" (Rule 4.10, 1975). Proved undeveloped reserves (PUD's) are "*those reserves that are expected to be recovered from new wells on un-drilled acreage, or from existing wells where a relatively major expenditure is required for recompletion*" (Rule 4.10, 1975). The difference between these terms is whether the major part of the investment required to produce and sell the oil and gas has already been made or not, i.e. if the wells have been drilled or not.

On the other hand, the definitions of the Society of Petroleum Engineers - World Petroleum Congresses (SPE-WPC) are the ones commonly used in oil and gas industry for decision making purposes, especially when managers need to decide on capital investments, but also they are more informative for investors when it comes to potential ultimate recovery of oil and gas (see Chevron's 2007 Annual Report, pp 28).

According to the SPE-WPC, reserves are divided into two main classifications: proved and unproved, depending on their relative degree of uncertainty. Proved reserves can be considered developed or undeveloped reserves similarly to what was already mentioned for the SEC definitions. Additionally, in contrast with SEC, these reserves can also be subdivided into producing ("*expected to be recovered from completion intervals which are open and producing at the time of the estimate*" (SPE, 1997)) and non-producing (include shut-in and behind-pipe reserves). Unproved reserves are "*based on geologic and/or engineering data similar to that used in estimates of proved reserves; but technical, contractual, economic, or regulatory uncertainties preclude such reserves being classified as proved*" (SPE, 1997). In conformity with the relative degree of uncertainty about reserves existence they can be classified as probable or possible.

On one hand, probable reserves are *"those unproved reserves which analysis of geological and engineering data suggests are more likely than not to be recoverable … when probabilistic methods are used, there should be at least a 50% probability that the quantities actually recovered will equal or exceed the sum of estimated proved plus probable reserves"* (SPE, 1997). On the other hand, possible reserves are "*those unproved reserves which analysis of geological and engineering data suggests are less likely to be recoverable than probable reserves … when probabilistic methods are used, there should be at least a 10% probability that the quantities actually recovered will equal or exceed the sum of estimated proved plus probable plus possible reserves"* (SPE, 1997). Neither one of the terms is recognized by SEC.

The meaning of these terms is so controversial among investors, analysts, managers and the press that they can even result in different values of oil and gas reserves[13] (Harrel). There are several definitions to categorize oil and gas reserves. Therefore, one well after being studied and drilled can have a quantity of oil that is considered a commercially viable discovery and that can be enough to start a development plan completely different depending on the reserves definitions that are considered valid. For instance, an evaluator can conclude there are 100 million barrels of proved oil (SPE-WPC 1997), or 50 million barrels of proved oil (SEC 1978) assuming "lowest known oil" as a conservative approach, or even zero (CIM 2002) if the reservoir was not flow tested. Because of that the SEC is addressing these definitions in the revision process of the standard in order to remove ambiguities.

In the annual reports of top oil and gas companies in the world, which we will analyze later, the quantities of oil and gas proved reserves disclosed in the unaudited supplementary

[13] See Harrell, R. (2008). Whose reserves estimates can I trust?. World Energy Magazine, 7(1). Available at http://www.worldenergysource.com/articles/text/harrell_WE_v7n1.cfm

schedules refer to the definition of proved reserves in Rule 4.10/SEC. Consequently, this will be the key definition in this dissertation.

## 2.2 Financial Accounting Standards

According to Financial Accounting Standard Board (FASB), if the analysis focuses on oil and gas reserves, the statement that regulates this subject is the Statement of Financial Accounting Standards No. 69 – Disclosures about Oil and Gas Producing Activities. This statement became effective for fiscal years starting December 15$^{th}$, 1982. As reported in SFAS 69, publicly traded enterprises, that have significant oil and gas producing activities, must disclose as supplementary information in their annual financial statements: proved oil and gas reserve quantities; capitalized costs relating to oil and gas producing activities; cost incurred in oil and gas property acquisition, exploration, and development activities; results of operations for oil and gas producing activities; and a standardized measure of discounted future net cash flows relating to proved oil and gas reserve quantities (paragraph 7 of FASB, 1982).

When it comes to International Financial Reporting Standards (IFRS) these do not provide any exact regulation for oils and gas reserves disclosures.

In order to understand the values reported by oil and gas companies, the center of our attention will be the disclosure of proved oil and gas reserve quantities, capitalized costs relating to oil and gas producing activities and a standardized measure of discounted future net cash flows relating to proved oil and gas reserve quantities (in the next subchapter).

### 2.2.1 Proved oil and gas reserve quantities

Firstly, disclosure of proved oil and gas reserves quantities refers to disclosure of the beginning and the end of the year of net quantities of crude oil, condensate and natural gas liquids and natural gas (exclude royalties and interests owned by others).

Secondly, the changes of proved oil and gas reserve net quantities that occur during the year should be also disclosed. Additions of proved reserves can be a result of purchases of mineral in place, extensions (of the proved acreage of previously discovered old reservoirs) and

discoveries of new fields or of new reservoirs in old fields. Extraction, production or sales of minerals in place will decrease the proved oil and gas reserves. Other type of changes due to revisions and reclassifications of previously estimated values or due to the usage of improved recovery techniques can increase or decrease the proved reserves.

Thirdly, proved oil and gas reserves shall be disclosed according to where they are located. In other words, if companies only have reserves in their home country they must reveal that fact, but if, on the contrary, they have reserves in several oil fields across the world, they must segment the significant reserves they own according to foreign geographic area, which can be single or groups of countries.

Finally, the unit in which reserves quantities are published in is very important. Therefore, companies must publish oil and natural gas liquids reserves in barrels and gas reserves in cubic feet.

The decision-making process in oil and gas companies is influenced by the impact of information about changes in proved oil and gas reserves, mainly due to the discoveries of reserves, as it is a key element of company success.

### 2.2.2. Capitalized costs relating to oil and gas producing activities

Capitalized costs are all costs associated to oil and gas producing activities, such as cost of equipment and facilities, cost of exploratory and development wells. Capitalized costs also include cost of leaseholds that companies have to pay to countries for allowing the exploration and drilling properties which are owned by countries. Additionally, the costs are capitalized when it is demonstrated that the oil and gas producing activities will generate future economic benefits.

When exploration of wells begins, all costs associated are capitalized. Once exploratory drilling activities are finished, the information is already available to determine whether proved reserves were found or not and, as a consequence, if costs remain capitalized or expensed. Thus, if proved reserves were found, all costs will stay capitalized and are subject to depreciation or depletion. If it is determined that there is no proved reserves, previously capitalized costs related to exploratory wells will be expensed in the year of determination (Occidental's Annual Report 2005).

According to SFAS 69, at the end of the year, the aggregate related accumulated depreciation, depletion, amortization and valuation allowances referring to the capitalized costs must be disclosed along with the capitalized costs. In addition, capitalized costs of unproved properties shall be disclosed individually, if they are significant. Investors benefit from this distinction, because it is easier to notice the degree of risk related to proved and unproved properties, which is higher in the latter. Another advantage of making this separation is the fact that investors can become aware of the company's holdings in properties, which can result in increased rising oil and gas production .

To conclude, the disclosures required by SFAS 69 are hugely important for understanding oil and gas producing activities. On the one hand, they emphasize the oil and gas reserves magnitude as an economic resource and the risks associated to geographic location of oil and gas producing activities. On the other, they are useful to recognize the reasonably long cycle from resource exploration to production, product sale and ultimate cash flow.

### 2.3 Oil and Gas Valuation

The valuation of oil and gas reserves is a very important factor in reputation and image of enterprises in this industry.

SEC Rule 4-10 of Regulation S-X required disclosure of "*a Standardized Measure of Discounted Future Net Cash Flows relating to proved oil and gas reserve quantities*" which shall be reported both in a value aggregating all reserves and also in segmented values by geographic area. According to the SEC, the valuation of oil and gas reserves should be based on economic, environmental and operating conditions existing at year end using, consequently, the year-end spot price for the barrel of oil, which means that reserves are valued on the last reporting day of the year – usually the 31$^{th}$ of December. For instance, in Total's annual report for 2007, which follows SEC requirements, we can confirm that their reserves were determined based on the Brent price of 31 December 2007 ($93.72/barrel). This was also the reference price used for the future cash inflows estimates.

When this rule was originally created, it was a time of stable petroleum prices, so it makes sense valuing oil and gas reserves at year-end-price as the variation across the year was very low. However, more recently, there has been high fluctuation in Brent price, for instance, in

2007 the Brent price began at $58.49/barrel and closed the year at $93.68/barrel, it reached $143.95 in July 2008 and in 2011 the year-end price was $108.09/barrel (U. S. Energy Information Administration, 2011).

In order to determine "A Standardized Measure of Discounted Future Net Cash Flows relating to proved oil and gas reserve quantities", the difference between the "Future Cash Inflows" and the sum of "Future Development and Production Costs" and "Future Income Tax Expenses" shall be calculated. "Future Development and Production Costs" refers to the estimation of expenditures (based on year-end cost indicators) related to year-end oil and gas proved reserves' development and production and "Future Income Tax Expenses" results from statutory tax rates (adjusted for tax deductions). Then, it is subtracted the "Discount" which is the amount resulted from using a 10 annual percentage discount rate, according with the estimated timing of cash flows. The anticipation of how many years the reserves will last is related to the life expectancy of reserves. Assuming that the production rate will keep approximately the same in future years, the division between total volume of proved reserves at year-end and the quantity extracted in that year results in determination of reserves life expectancy[14].

To conclude, it is important to clarify that SEC adopted the standardized measure described above for the valuation of oil and gas reserves, preferring a conservative approach rather than the use of fair market value.

### 2.4 Theoretical Background – Hotelling Principle

Since the beginning of 20th century, the concern about rapid extraction of oil and the fear of running out of oil has been installed in the world. Oil is a non-renewable resource and it is nowadays the world's most important energy source.

In 1931, Harold Hotelling wrote a paper named "The Economics of Exhaustible Resources", in which he analyzed how to manage the exploration of non-renewable resources. The

[14] See Environmental Accounts branch – Office for National Statistics, The valuation of oil and gas reserves, 1999. Available at http://unstats.un.org/unsd/envaccounting/ceea/archive/Energy/UK_Oil%20and%20gas%20reserves%20valuation.PDF

Hotelling's Principle is explained in this paper and it defines the rule for efficient exploitation of non-renewable resources over time – the growth's percentage of price should equal the discount rate. In other words, the difference between the price of a non-renewable resource and the marginal extraction cost will increase over time at the rate of interest (the rate of return on comparable assets). This allows for the maximization of the present value of resources during the extraction period. This economic principle supports the analysis. Hence, as oil is limited, its production diminishes as available reserves deplete, which implies a contraction of the supply curve. The price will increase and, consequently, demand will decrease. The situation described according to Hotelling's Principle is in fact aligned with the interests of oil companies because it yields better profits. Hotelling showed oil companies should supply their oil in an efficient way over time in order to rise their own profit; otherwise if the supply oil too fast, they will not maximize their profit[15].

Although most of the literature[16] related to exhaustible resources, mainly oil reserves, their valuation, price and extraction, is based on Hotelling models, Hotelling's results and assumptions are target of some criticism.

First of all, during the 90s the price of minerals decreased, which contradicted what Hotelling proposed. This was explained by two authors in different ways: Pindyck[17] stated that a reason for prices to decrease was the declining of costs across years; Adelman[18] argued that as a result of not having a fixed stock of resources to allocate, prices would not increase.

[15] See Hotelling, H., The economics of exhaustible resources, Journal of Political Economy Vol. 39, No. 2, pp. 137-175, April 1931. Available at SSRN: http://www.jstor.org/stable/1822328

[16] See Balsdon, E. and Deacon, R. T., Exhaustible Resources, Economics of, International Encyclopedia of the Social & Behaviour Sciences, 5051-5058, 2001; Fishelson, G., Hotelling rule, economic responses and oil prices, Energy Economics, 5 (3): 153-156, 1983; Khanna, Neha, On the Economics of non-renewable resources, Economics interactions with other disciplines – Vol.II, 2001. Available at http://www.eolss.net/Sample-Chapters/C13/E6-29-03-01.pdf

[17] See Pindyck, R.S., The optimal exploration and production of nonrenewable resources, *Journal of Political Economy*, Vol. 86, pp. 841–861, 1978.

[18] Adelman, M.A., Modelling world oil supply, The Energy Journal, Vol. 31, pp. 101–122, 1993.

Lin and Wagner[19] also agree that the Hotelling rule does not represent the reality of mineral prices. Their paper revises the Hotelling model and explains the mineral price evolution through stock effects and technological development. These two elements are the opposite of Hotelling's assumptions – constant marginal extraction costs, independently of extraction rate and remaining stock, and no technological progress.

> *"Stock effects increase extraction costs and are consistent with rising resource prices, while technological progress lowers extraction costs and causes prices to decline."*[16]

On the one hand, the more resources are extracted achieving further depths, the fewer reserves remain, which leads to an increase in extraction costs and consequently rises mineral prices. On the other hand, technological progress and innovation improve the extraction capacity, allowing for an extraction cost reduction.

The fixed and known reserves size and the optimal resource allocation supported by Hotelling is not consensual as well. Farzin[20] outlines the shortcomings of Hotelling's Principle's assumptions, when applied to the current oil industry:

> *"First, they assume that the size of reserves are fixed and known, thus discarding the effect of resource price on economically recoverable reserves. Second, they are primarily concerned with the determination of the resource extraction path based on intertemporal arbitrage of profits from production activity, thus abstracting from economic decisions regarding reserves development and discovery, which are crucial to the growth of reserves."*[17]

Farzin and some other works[21] defend that the size of reserves is not static and some factors like exploration activity, price and technology influence the size of reserves. Farzin developed an economic model of the additions to proven reserves' process introducing an economic concept of reserves (an innovative factor since reserves additions are viewed primarily as a

---

[19] Lin, C. & Wagner, G. (2007). Steady-state growth in a Hotelling model of resource extraction, Journal of Environmental Economics and Management, Vol. 54 (1), pp. 68–83, 2007. Available at: http://www.gwagner.com/research/hotelling/Lin_Wagner_Hotelling.pdf

[20] Farzin, Y.H., The impact of oil price on additions to US proven reserves, Resource and Energy Economics, Vol. 23 (3), pp. 271–291, 2001. And "An Economic Model of Oil reserves Additions: Application to U.S. Data", available at http://www.feem.it/userfiles/attach/Publication/NDL1998/NDL1998-096.pdf

[21] MacAvoy, P.W., Pindyck R.S., Economics of Natural Gas Shortage (1960–1980), 1975; Pesaran, M.H., Samiei, H., Forecasting ultimate resource recovery, International Journal of Forecasting, Vol. 11, pp. 543–555, 1995 and Pindyck, R.S., The optimal exploration and production of nonrenewable resources, Journal of Political Economy, Vol. 8 (4), pp. 3–17, 1978.

geological outcome). The reserves growth can be explained both by the discovery of new fields as a result of drilling exploratory wells and by the additions to reserves in known fields through extensions. The model focuses on this last point and integrates the effects of expected resource price, cumulative reserves development and technological advancement. Through the reserves estimations analysis, the study concluded that the increases in oil price are crucial to the growth of proven reserves resulting from development of existing fields.

Associated to the peak of oil theory, Watkins[22] deals with the concern of the oil scarcity over the last three decades. Watkins states that:

> *"oil is more plentiful now in an economic sense than in 1973. The reason for such misconceptions lies mainly in reliance on analytical techniques that do not comprehend oil as an economic commodity."*[19]

Indeed, proved oil reserves increased by 80% approximately and production grew by 30% in thirty years, as Watkins exposed in his study. Moreover, there are new players, there is a rigorous development of existing plays, innovative technology and lesser reliance on OPEC information. Thus, there are no plausible explanations that justify resource shortage.

[22] Watkins, G.C., Oil scarcity: What have the past three decades revealed?, Energy Policy, Vol. 34 (5), pp. 508–514, 2006. Available at http://shadow.eas.gatech.edu/~kcobb/energy/Readings/Watkins.pdf

# CHAPTER 3:
# FINANCIAL ACCOUNTING STANDARDS EVOLUTION

## 3.1 Information Problem

It was until 1938 that oil was discovered in the Middle-East, and since then this region has turned into the world's largest producer of oil by far. In 1960, five oil producing developing countries (Venezuela, Iran, Iraq, Saudi Arabia and Kuwait) founded The Organization of the Petroleum Exporting Countries (OPEC), which is currently the key player and has a massive market power in the oil industry. This is explained by the fact that OPEC exports approximately 55% of the total oil traded worldwide. Because of its coordinated production and supply practices, OPEC is considered a cartel, and has, therefore, a strong influence in the oil price[23] (Houthakker, 1976). Nowadays, OPEC has 12 members ranging from the Middle East (the four Middle Eastern founders, Qatar and the United Arab Emirates), South America (Venezuela and Equador), and Africa (Algeria and Libya in North Africa, Angola and Nigeria in Sub-Saharan African).

While analyzing the oil market, it is clear that the information problem persists, mainly in what the Middle East reserves are concerned. Most of the largest reserves located there are held by non-publicly listed companies, therefore the information on these reserves is scarce, as the majority of it is confidential and the published data are poorly and unreliably reported (see Jean Laherre's "Estimates of Oil Reserves", 2001, for a discussion of the quality of oil reserves information). Thus, conclusions about oil reserves status, extraction rates and available quantities have to be drawn from unaudited statements and comments published in the specialized press. Consequently, oil companies operating from the Middle East can manage that information according to their interests. The uncertainty about Middle-East reserves is not a single case. Little is known, as well, about the Russian and Chinese oil reserves[24] (Bentley, 2002). Moreover, there is no independent verification of production capacity installed nor is there an independent valuation of reserves in these places. However,

[23] Houthakker, H. S. (1976). The world price of oil – a medium-term analysis. American Enterprise Institute for Public Policy Research

[24] Bentley, R.W. (2002). Global oil & gas depletion: an overview. Energy Policy, 30, 189–205

a good analysis of the oil market should take into account only verifiable technical data[25] (Laherrere, 2001).

Another information problem that generates ambiguous data is *when the same field is shared by two countries* (Laherrere, 2001). Depending on the field location, the mineral rights belong to the correspondent state. Therefore, in order to explore and extract the hydrocarbons of the field, companies have to make an agreement with the government of the country in which the field is located, so that they can obtain the concession or the right of exploration, giving in return rents, taxes and royalties to the government. However, in the example of Statjford field, located across the Norwegian and the UK North Sea Boundary, the problem lies in the difference in the estimated growth of the oil annual production made by two national agencies. This implies that there are two distinct values for the same field/oil reserves.

In addition to that, in some countries, data on reported reserves is not updated on a yearly basis, which leads to inadequate and inconsistent information[26] (Bentley, 2002 and Laherrere, 2001).

Although in some countries there are legal requirements for publishing data on oil and gas reserves, the truth is that in others there are no such rules and, consequently, they have no obligation to making them available. As expected, oil and gas companies rather keep their knowledge and information confidential, otherwise competitors could take advantage of that. Nonetheless, if oil and gas companies were to disclose the data legally required, they would be certainly contributing to provide an image of transparency that is often lacking in this industry (Laherrere, 2001).

### 3.2 The Problem of Oil and Gas Reserves Reporting

Although, confidentiality and lack of information about oil and gas reserves data are two established features of the oil and gas industry, there are many other problems associated with information provided in companies' annual reports. In other words, the problems are not only

[25] Laherrere, J. (2001). Estimates of oil reserves. Available at: http://www.iiasa.ac.at/Research/ECS/IEW2001/pdffiles/Papers/Laherrere-long.pdf

[26] Bentley, R.W. (2002). Global oil & gas depletion: an overview. Energy Policy, 30, 189–205

related to the quantity of information, but also with the quality of the information disclosed by oil and gas companies in what the reserves reporting is concerned. Very often the information disclosed is not understandable and seems to be purposely confusing.

The fact that the SEC privileges a conservative approach – for instance, resorting to definitions of reserves that are not consistent with the ones used commercially - does not allow disclosures to accurately reflect reality and gives some room to companies for managing their information, that may be misleading to shareholders and outside investors.

There are five types of problems in what oil and gas reserves reporting are concerned.

1. According to the SEC rules, oil and gas companies listed in the U.S. only have to disclose proved reserves, thus, probable and possible reserves are omitted. This conservative approach contrasts with the current practices of the rest of the world, as probable reserves are usually reported. Probable reserves are characterized for having a certainty of being produced of 50% or more (when probabilistic method is used), which means that, in the next years, they are more likely than not to be recoverable and re-categorized into proved reserves. According to Jean Laherre's "Estimates of Oil Reserves", 90% of reserves additions are due to revisions of past estimates, in which probable reserves had not been taken into account. Indeed, the disadvantage to analysts is that the growth of reserves is more influenced by the reclassification of probable reserves into proved reserves, then by new findings. This allows companies complete discretion in the timing of announcements of "new" proved reserves discoveries.

Nevertheless, as the reported reserves represent a conservative view, since the SEC assumes that proved reserves estimation is made with "reasonable certainty", any modification after having done this estimation is much more likely to be positive than negative. Hence, the SEC rules promote upward revisions and avoid downward ones.

This explains why Shell's 2004 downwards revision caused such a big uproar in the markets. Shell announced that it would revise their proved reserves, reducing them not by a little fraction, but decreasing them by about 20% – around four billion barrels. As a result, Shell was accused of having previously overstated their reserves intentionally, including turning non-proved reserves into proved reserves. The majority of the adjustments on their oil and gas reserves done in 2004 came from the Nigeria and Australia fields and were explained by a

reduction of proved undeveloped reserves (90%) and proved developed reserves (10%), since those reserves did not meet the accounting standards for being recognized as proved reserves. However, Shell's managers actually knew about shortfall of reserves for years but they were kept secret, misleading the market. Consequently, this write-down revision had a huge impact on Shell's value and also on investors' confidence. This case supports the idea that reported reserves do not provide a realistic image. Moreover, the significant drop in Shell's market value is also an indicator that the market still pays attention to these disclosures or, at least, distrusts lying about reserves.

2. In what the reported quantities for reserves are concerned, a deeper understanding of reserves changes is necessary, since numerous problems arise with determining why these reserves increase or decrease.

The different explanations for increasing or decreasing the reserves have already been mentioned above. Namely, we already pointed out that a substantial number of the increases in reported reserves cannot be explained by technological development on the extraction of the existing reserves, or even by the geological finding of additional new ones. Rather they are a result of the conservative reporting and the fact that this allows for constant reclassification of probable or possible reserves into proved reserves, a simple accounting rebranding. This leaves the real addition of physical oil and gas to the companies' reserves (for technological or geological developments and discoveries) to the increase in probable or possible reserves. Yet, these are hardly reported and even less subject to auditing or independent analysis by outsiders to the oil and gas companies. Hence, the addition of reserves is left to the judgment of managers, who can time the announcements of *new* proved reserves according to their own incentives.

3. Another problem of the quantities reported as reserves is the measurement units used (Laherrere, 2001). According to the SEC, oil reserves and natural gas liquids reserves shall be stated in barrels (bbl) and gas reserves shall be stated in cubic feet. However, the unit of measurement is not unique across the world. For instance, Oil and Natural Gas Corporation Limited (ONGC) is an Indian petroleum company, which reports its oil reserves in mmt (million metric tonnes) and its gas reserves in bcm (billion cubic meters). Therefore, when investors want to analyze the reserves quantities of two companies from different countries and must use distinct measures, they face an enormous obstacle, since conversions are not

simple at all. Given that units in which reserves are published vary across countries, information is not homogeneous and it is not easy to compare.

This seems an easy problem to solve since, 1bbl = 158.987 liters and 1cubic ft = 0.028 cubic meters. The conversion from a volume measurement unit (such as barrels and liters) into a weight measurement unit (such as tones) depends on the density of the oil, and this information is not disclosed by the company. The problem is also that crude oil is not homogenously dense all over the world, with density depending on the quality of the oil and its origin[27]. This was also a problem for Gazprom AOA. In the conversion of the gas reported reserves by ONGC, Ltd in 2007, there is no plausible explanation to amount 11,876,534 bcf, which alone would constitute the world's largest gas reserve and almost twice the total estimated[28] world gas reserves.

3. The valuation of oil and gas reserves is made with variables that have some intrinsic problems. The valuation of oil and gas reserves is presented in the "Standardized Measure of Discounted Future Net Cash Flows and Changes Therein Relating to Proved Oil" table. In order to get Cash Inflows, the reserves quantities are multiplied by year-end barrel price. As it was already mentioned, when SFAS 69 was created, it was a time of stable prices, so it made sense to value reserves at barrel price of year-end as it represents the value of reserves across year. However, in recent years, it has been noticed that an era of instability and uncertainty about barrel prices has began. Since there is high fluctuations of oil barrel price, it is not correct to take a year-end price as representative for the entire year. Hence, year-end barrel price does not reflect the value of reserves across the year and it results in overvaluation or undervaluation.

We attempted to match the value of the reported reserves multiplied with the barrel price on December 31st with the value of the "future cash inflow" reported by the firms. However,

[27] The American Institute of Petroleum developed a measurement of density of petroleum (so called API gravity). An API of 10° API is equivalent to water density. Natural bitumen can have API below 10, which means it is heavier than water (1000kg/$m^3$). However, it is a commonly known fact that most oil floats, as one just needs to bear in mind the environmental consequences of oil spills. Hence the API on lighter crude oil can go all the way to 45° (around 800kg/$m^3$). Naturally, since the companies hardly disclose the quality (or average quality) of their reserves, it becomes really hard to compare or add quantities from different origins.

[28] BP Statistical Review of World Energy, June 2012. Available at: http://www.bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2012.pdf

such a value is impossible to determine from the available information, as there must be other factors, besides the price, that influence this step, which are not referred or explained and we were not able to accurately identify, as we did not obtain a matching result. A substantial amount of crucial information needed to calculate the "future cash inflows" is not disclosed in the reports. For instance, the estimated timing of cash-inflows is not discriminated, nor do the firms disclose the extraction rate throughout the several years, or the time horizon over which they believe the reserves can be exploited.

4. Capitalized costs are very poorly reported, giving a weak view of specific costs that companies have to "incur" with the goal of developing, expanding, drilling and exploring fields.

5. Last but not least, the oil and gas industry uses many different concepts/definitions which are not homogeneous across worldwide. The SEC uses a specific terminology which is not equal to the one commonly used commercially. There is no consensus about definitions used and they are not clear or easy to understand, nor do they establish simple limits to what companies can or not enclose on each concept. Therefore, this adds noise/problems to oil and gas reserves reporting, because, depending on the definitions used, the values are completely different.

In conclusion, "the incorrect reserve reporting" results in valuation problems and weaker investor confidence. The different types of reporting problems that persist in the industry allow oil and gas companies to overvalue or undervalue reserves that they actually own. Moreover, the fact that under US standards – SFAS 69, reserves quantities are unaudited and it is not required that reserves are prepared by an independent engineer (unlike what occurs in Canada) gives room for more omissions or additions to quantities and decreasing, therefore, the truth, confidence and reliability of numbers reported.

### 3.3 New Financial Accounting Standards – Modernization of concepts

On December 29th, 2008, SEC announced the revisions made to oil and gas reserves reports. It had been more than 25 years since the rule was last reviewed. Hence, the SEC updated the disclosure requirements for oil and gas companies in order to integrate the changes that

occurred in the last decades, not only in the characteristics of the industry but also in the terms used by the majority of its players.

With the purpose of understanding better what changes SEC should make, firstly, a concept release for public comment was issued, and then a proposing release in order to get more feedback. With those comments the "rule amendments" were formulated, and became effective since the 1st of January 2010.

Although the modernization of oil and gas reserves requirements and definitions has no effect on balance sheets of companies, it is decisive, since it improves the quality and transparency of information and helps investors in their investment decision making by providing more clarified disclosures. The revisions were focused in diversified subjects.

The new rule allows disclosures of probable and possible reserves (allows but not mandates), while in the previous rule, only proved reserves are allowed. This modification is in alignment with the London Stock Exchange and the Australian Stock Exchange practices, as they require the disclosure of proved and probable reserves. SEC proposed defining probable reserves as *"those additional reserves that are less certain to be recovered than proved reserves but which, in sum with proved reserves, are as likely as not to be recovered"*[29] and possible reserves as *"those additional reserves that are less certain to be recovered than probable reserves"*[30]. While probable reserves (added to proved reserves) have a 50% chance of economic recovery, possible reserves (added to proved and probable reserves) only have 10%.

As it was already mentioned in previous chapter, the old rule only approved the classification of developed or undeveloped reserves to proved reserves because they were the only ones with allowed disclosure. With this revision, the classification of developed or undeveloped reserves is not only applied to proved reserves but also to possible and probable reserves, accordingly to development status of the reserves.

Proved reserves definitions are modified. The concept of "reasonable certainty" used in oil and gas proved reserves definition is, for the first time, defined by SEC as a "high degree of

[29] SEC (2009), "Modernization of oil and gas reporting". Available at: http://www.sec.gov/rules/final/2008/33-8995.pdf, page 38

[30] SEC (2009), "Modernization of oil and gas reporting". Available at: http://www.sec.gov/rules/final/2008/33-8995.pdf, page 39

confidence that quantities will be recovered" along with "high degree of confidence" means "much more likely to be achieved than not". Moreover, the concept of "reliable technology" becomes wider, including more new different technologies that companies can use to estimate reserves. "Reliable technology" is defined by the new rule as a group of technologies that *"has been field tested and has been demonstrated to provide reasonably certain results with consistency and repeatability in the formation being evaluated or in an analogous formation"*[31]. Finally, the new rule changes the requirements of disclosure reserves by geographic area. Oil and gas companies have to report their reserves by groups of countries or as an individual country. More detailed, if companies have 15 percent or more of their total reserves placed in an individual country, they must disclose each country separately unless a single field is revealed or the disclosure of particular fields are prohibited by the law of that country.

SEC proposed an expansion of proved undeveloped reserves definition. According to the new rule, oil and gas companies can also apply the new term of "reasonable certainty" in order to calculate the quantity of proved undeveloped reserves and can report their proved undeveloped reserves despite their place. Additionally, under the old rule there is a deadline of five years in which companies can keep their proved undeveloped reserves that continue undeveloped. In contrast, the new rule eliminates that limit, allowing companies to report proved undeveloped reserves that persist undeveloped as a result of "specific circumstances", but requires the disclosure of justification for those reserves keep being classified as undeveloped (for instance when it is needed to construct a pipeline or processing facility firstly).

The new rule establishes the valuation of oil and gas reserves using an average price based upon the prior 12-month period rather than a single day year-end prices to "determine the economic producibility of reserves". More detailed, it consists in a non-weighted arithmetic average of the first day of each 12 month prior to the end of the company's fiscal year (characteristically 1st January through 1st December). Nevertheless, companies should use the contractual price, if this is established by contractual arrangements, without considering any price escalations based upon future conditions. This change it is intended to improve the comparability among companies in what the reserves owned by them are concerned and, at

[31] SEC (2009), "Modernization of oil and gas reporting". Available at: http://www.sec.gov/rules/final/2008/33-8995.pdf, page 142

the same time, minimize the volatility and seasonality that is caused by the use of a single day price. The replacement of how oil and gas reserves are valued will have a huge repercussion on companies. For example, considering the prices of barrel in 2007, the year-end spot price is $93.68/barrel while using average will result in lower price ($71.85/barrel) given that it was a year of increasing prices. In contrast, taking into account barrel's prices of 2008 the result using average is much higher than use year-end price because on 1st January the price was $97.01/barrel ending the year at $35.82/barrel, reaching on July the highest value since ever of $143.95/barrel.

SEC proposed an expansion of the definition of "oil and gas producing activities", turning possible the reporting of non-traditional resources, which previously were considered mining reserves, as oil and gas reserves. In accordance with the old rule, in "oil and gas producing activities" activities associated to the extraction of bitumen and other non-traditional resources are excluded (e.g. oil sands, shales and other nonrenewable natural resources). Consequently, only sources of oil and gas that engage extraction by traditional oil and gas wells were included. However, thanks to technology development and extraction techniques evolution, the category of unconventional resources had a massive expansion. The new rule differs from the old one because it focuses on the final product. For that reason, oil and gas companies are able to include in "oil and gas producing activities" the extraction of *"saleable hydrocarbons, in the solid, liquid, or gaseous state, from oil sands, shale, coalbeds, or other nonrenewable natural resources which are intended to be upgraded into synthetic oil or gas, and activities undertaken with a view to such extraction"*[32].

The modernized rule sets up a new requirement in order to ensure a clear and independent estimation of oil and gas reserves. Companies are required to disclose and describe the internal controls and the qualifications of the technical person who is responsible for the reserves estimation process, independently of being an employee or a third party. If the reserves estimations are made or audited by a third party, companies have to incorporate in their information disclosure a report made by this third party, in which all the assumptions, methodologies, analysis, results and conclusions are stated and discussed.

[32] SEC (2009), "Modernization of oil and gas reporting". Available at: http://www.sec.gov/rules/final/2008/33-8995.pdf, page 22

SEC gives the option, but does not require the disclosure of reserves price sensitivity. Companies are allowed to disclose the sensitivity of oil and gas reserves estimates accordingly to price variation, assuming various possible scenarios or test cases. Indeed, the goal is making more useful information available to investors, mainly in periods of high variation prices. However, the assumptions, prices and costs that support those alternative scenarios created by companies can be so unpredictable and unreliable that investors cannot take advantage of that information or even create an untruthful image of the company.

A new position to methods used for reserves estimation is adopted by SEC. While in the old rule SEC prefers the determinist method but also permits the probabilistic method (not defined), in the new rule SEC recognizes the use of probabilistic method, defining the percentages similar to PRMS definitions. Thus, SEC established that *"if deterministic methods are used, reasonable certainty means a high degree of confidence that the quantities will be recovered"*, and *"if probabilistic methods are used, there should be at least a 90% probability that the quantities actually recovered will equal or exceed the estimate"*[33].

The modernization of oil and gas companies reports requirements and definitions were aligned with current ones of Petroleum Resource Management System (PRMS), whose practices and standards are widely accepted and developed by prestigious organizations which some were pointed out before like WPC and SPEE.

With the purpose of understanding better which changes are more important to oil and gas companies, we analyzed all comments to concept and proposing release submitted to the SEC. Thus, we can conclude that the changes that are more frequently stated in the comments are the ones that have more relevance to companies. Since the questions of concept release are different from the ones made in proposing release, we built two rankings of comments that are shown in table 3.1 and table 3.2. On comments to concept release (SEC, 2007), companies pay more attention to pricing, disclosure only proved reserves versus option disclosure probable and possible reserves, adopt SPE-PRMS, reserves review by an independent third party, remove restrictions to unconventional oil and gas reserves, revision of definitions as "reasonable certainty" and specify tests under taken to estimate reserves (by order of significance). Pricing, remove restrictions to unconventional oil and gas reserves and

[33] SEC (2009), "Modernization of oil and gas reporting". Available at: http://www.sec.gov/rules/final/2008/33-8995.pdf, page 29

disclosure only proved reserves versus option probable and possible reserves, revisions of proved reserves definitions (use new technology), alignment PUD and PD recognition thresholds at “reasonable certainty”, adopt SPE-PRMS, reserves audits and third party reserves review, disclosure qualifications of personal responsible for reserves estimates and optional reserves sensitivity analysis are the ranking of comments in proposing release (SEC, 2008). Summing up, the two most important changes that concern oil and gas companies are pricing - 12 month average, and optional disclosure probable and possible reserves.

**Table 3.1.** Ranking of Comments on Concept Release

| **Ranking of Comments on Concept Release** | | **% stated** |
|---|---|---|
| **1º** | Price 12 month average | 66.3 |
| **2º** | Disclosure Only Proved Reserves | 61.3 |
| **3º** | Adopt SPE-PRMS | 57.5 |
| **4º** | Independent Third Party | 56.3 |
| **5º** | Remove restrictions to unconventional oil and gas reserves | 55.0 |
| **6º** | Revise the term "reasonable certainty" and "economic producibility" | 45.0 |
| **7º** | Specify tests undertaken to estimate reserves | 23.8 |

**Table 3.2.** Ranking of Comments on Proposing Release

| **Ranking of Comments on Proposing Release** | | **% stated** |
|---|---|---|
| **1º** | Price 12 month average | 78.5 |
| **2º** | Disclosure Only Proved Reserves<br>Remove restrictions to unconventional oil and gas reserves | 53.8 |
| **3º** | Revisions of Proved Reserves def. - use new technology | 52.3 |
| **4º** | Revise the term "reasonable certainty" | 47.7 |
| **5º** | Adopt SPE-PRMS | 43.1 |
| **6º** | Reserves Audit & Third party reserves reviews | 38.5 |
| **7º** | Disclosure Qualifications of P. Resp. for R. Estimates | 35.4 |
| **8º** | Optional reserves sensitivity analysis | 26.2 |

The analysis of the comments not only identifies what the main changes are, but also gives the perception of direction that companies wanted the new rule to have. In other words, some changes can be viewed as more liberal, because they allow for the report of more reserves (giving the option to disclosure probable and possible reserves, removing restrictions to unconventional resources, using new technology) and others tougher, because they require supervision and the control of the techniques used to determine reserves (third party reserves review, disclosure of qualification of who takes part in reserves estimation process and specification of tests applied in reserves estimation). Additionally, the optional disclosure of sensitivity analysis can be considered far too liberal, as companies can take advantage of high variation of prices used, to say that they own much more reserves than they actually own or the opposite situation.

Firstly, let us look at the companies which actually comment on concept release.

- 37% of these companies agree that the price used should be the 12 month average rather than year end price.
- In what concerns the disclosure of reserves, 61% prefer optional disclosure of probable and possible reserves, instead of disclosure only proved reserves, turning the rule more liberal as possible in order to disclosure more reserves.
- The adoption of SPE-PRMS definitions and guidelines is considered the best option by 61%, as it provides a worldwide union, comparability, clarity and easier understanding of oil and gas industry' standards.
- Concerning the reserves revisions made by an independent third party, 44% say that they should not be mandatory, otherwise they will support the decision of making the rule tougher.
- 66% of the companies support that the restrictions to unconventional oil and gas reserves should be removed.
- The majority of companies agree that the terms "certainty" should be revised.
- Only one company of 19 which commented this issue agrees that specified tests should be undertaken to estimate reserves.

Secondly, the opinions on the proposing release are analyzed.

- The modification of pricing to 12 month average keeps being supported by the greater part of companies (84%), as well as the elimination of restrictions to non-conventional resources (97%).
- Almost 72% of companies do not agree on disclosing only proved reserves, they want the possibility to disclosure probable and possible reserve, thus the new rule will allow more reported reserves.
- Regarding the new term "reliable technology", 62% supports the use of new technology (more liberal than the old one) in order to determine reserves.
- The definition of "reasonable certainty" is also revised and 45% of companies agree with the alignment of PUD and PD recognition threshold at "reasonable certainty".
- All companies support the use of SPE-PRMS definitions and standards.
- In what concerns the audit revision, 48% disagree with that requirement; they do not want tougher rules.
- 44% agree that the disclosure qualifications of the personal responsible for reserves estimates should not be required; here, once again they would not like tougher rules.
- Finally, on optional reserves sensitivity analysis 53% agrees with this disclosure, evidencing how liberal companies are.

Therefore, there is no proposed modification, which companies would prefer to be tougher.

Looking in general to all the conclusions, oil and gas companies prefer that a more liberal rule. Additionally, we can deduce that companies want to know more about reserves of other companies and also want to say more about their own reserves.

At this instance, it is important to compare the analysis of the comments made by every company and the ones made by "top companies".

On comments to concept and proposing release, there is a consensus on opinions gave by all and top companies, which means they share the same concerns and attitude. The unique distinction is that in the option disclosure of sensitivity analysis (proposing release), top

companies have a clear opinion that it should not be required and in disclosure only proved reserves (concept release), top companies are divided (4 agree and 4 disagree).

It is also pertinent to compare the differences among top companies' opinions, mainly if they change the opinion from concept to proposing release or not. This is evidence of how the commenting firms take ambiguous positions in terms of siding with more liberal or conservative opinions. As a matter of fact, no pattern of either conservatism or liberalism can be drawn from the several commenting firms, as the same firms show up on both sides of the spectrum. What follows are a detailed set of examples of this ambiguity.

The majority part of companies, which gave the opinion in concept and proposing release, agree with the disclosure of non-proved reserves, because it enhances the information provided, gives a better outlook of the asset evaluation and meets investor's demand. However, there are other companies, such as Repsol, Imperial Oil, ENI and BP, which state that it only reported proved reserves should be due to the high risk and uncertainty that probable and possible reserves are linked to, having a more conservative approach in this aspect. Shell changed the opinion from concept to proposing release and one possible explication is the fact that it was written by a different person, meaning that even inside the company there is no consensus.

Statoil Hydro, EnCana and Petrobras are in favor of requiring a preparation of reserves estimates by an independent third party or reserves audits. This fact represents one way of independent evaluation and gives more reliability to the information disclosure. Nevertheless, the companies which are against to this modification emphasize that the reserves estimation process is very complex and it is managed in a long term base, therefore the best qualified to evaluate reserves are the commercial and technical employees.

The revision of pricing is supported by all top oil and gas companies, accordingly with the comments made, with the exception of Statoil Hydro which prefers the use of future prices because *"ideally they represent risk discounted price forecasts"*[34]. Total stated that the use of 12 month average pricing will *"help smooth price variations from year-to-year while still allowing for consistency"*[27]. BP affirmed that the new pricing will *"represent better the exiting economic conditions"*[35]. Imperial Oil justified the elimination of year-end pricing for the reason that it *"does not provide meaningful*

[34] SEC (2008), "Proposing Release". Available at: www.sec.gov/comments/s7-15-08/s71508.shtml

[35] SEC (2007), "Concept Release". Available at: www.sec.gov/comments/s7-29-07/s72907.shtml

*information to investors and does not necessarily provide a good basis to evaluate a company's enterprise value"*[28]. Moreover, Shell has the opinion that single year-end price is an artificial and unrealistic determination of reserves value.

On proposing release, EnCana, Shell, Total, Petrobras and Repsol sustain the use of new technology since *"it makes technical and business sense" and "it will make the internal reserves analyzes more consistent"* [27]. It should be noticed that ENI views the disclosure of technologies as a non-viable requirement, since the process of reserves identification involves the use of multiple technologies. Oil and gas companies can take advantage of this revision for the reason that new technology makes it "economically" possible to produce more proved reserves given that it is cheaper than the old one, having better margins. However, it makes less sense when oil and gas companies argued that it was "non-economically" viable produce proved reserves when price of oil was low.

EnCana is the single company out of the four that agrees with the disclosure of reserves preparers qualifications. EnCana thinks that it is a high responsibility process as reserves estimates have consequences on oil and gas companies' valuations. The companies that do not share the same opinion, such as Shell, Eni and Total, believe that this requirement is unfeasible given that in large companies, as it is the case, there are several specialists who prepare the reserves estimates across the world.

The only change that top companies, such as Shell, Petrobras, Exxon and Repsol, have a tough position on is in their strong opposition to the disclosure optional of sensitivity analysis. Their justifications are: since the reserves are produced across different years, a sensitivity analysis based on year-end or 12 month average price does not make sense; it does not give material information to the investors as each company determines a distinct multiple price scenarios; it is not cost benefit justified; and promotes lack of comparability among oil and gas companies. Only Statoil Hydro and Total are viewed as liberals and support this optional disclosure.

In summary, SEC is relaxing the current rules, which is in conformity with the will demonstrated by oil and gas companies as the analysis of their comments verifies and there is no unanimity in the side taken by the commenting firms. As a matter of fact, there is a lot of ambiguity in these comments

# CHAPTER 4:

# CASE STUDY: "25 TOP OIL AND GAS COMPANIES"

## 4.1 Data Collection

In order to analyze the reported reserves worldwide, 25 oil and gas companies constitute the sample chosen to be examined in the case study. These 25 top oil and gas companies across the world were collected from a ranking named "Platts Top 250 Global Energy Companies" for 2007, in which companies are positioned accordingly with their financial performance, defined by a special Platts formula that includes assets value, revenues, profits and return on invested capital (ROIC). We exclude the electricity companies which are also in this energy companies ranking, and other oil and gas company that do not have available information. The 25 top oil and gas companies remaining in our sample are in the table 4.1, listed according to the position in the original ranking.

The total net proved developed and undeveloped reserves across nine years (2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010 and 2011) were gathered from the 25 top oil and gas companies' annual reports. In more detail, the oil and gas reserves quantities are generally reported in "Reserve Quantity Information", a table which is included in "Supplemental Information on Oil and Gas Producing Activities Unaudited". The unit of oil reserves is millions of barrels (MMbbl) and the unit of natural gas reserves is billion cubic feet (bcf). The major part of companies discriminate their oil and gas reserves by areas (country or group of countries), although it is not a common practice.

Therefore, the oil and gas reserves of the 25 top companies were summed by year and by area, since the goal is to determine if the oil and gas companies are underestimating or overestimating their reported reserves. Thus, it is possible to compare with the world total reserves per year and according with reserves' place. In addition, the evolution of oil and gas reserves is analyzed.

**Table 4.1.** Platts Ranking of Top Energy Companies (Platts, 2007)

| Rank | Company | Country (state) |
|---|---|---|
| **1** | ExxonMobil Corp. | USA (Texas) |
| **2** | BP plc | UK |
| **3** | Royal Dutch Shell plc | UK |
| **4** | Chevron Corp. | USA (California) |
| **5** | Total | France |
| **6** | Petrochina Co. Ltd. | China |
| **7** | StatoilHydro ASA | Norway |
| **8** | ENI SpA | Italy |
| **9** | Petrobras Brasileiro | Brazil |
| **10** | ConocoPhillips | USA (Texas) |
| **11** | LUKOIL Oil Co. | Russia |
| **12** | Marathon Oil Corp. | USA (Texas) |
| **13** | China Petroleum & Chemical Corp. | China |
| **14** | Rosneft Oil Company | Russia |
| **15** | Gazprom OAO | Russia |
| **16** | Occidental Petroleum Corp. | USA (California) |
| **17** | EnCana Corp. | Canada |
| **18** | Norsk Hydro AS | Norway |
| **19** | Repsol YPF SA | Spain |
| **20** | Gaz de France | France |
| **21** | BG Group plc | UK |
| **22** | Imperial Oil Ltd. | Canada |
| **23** | Hess Corp. | USA (New York) |
| **24** | CNOOC Ltd. | Japan (Hong Kong) |
| **25** | OMV AG | Austria |

## 4.2 Data Analysis

After the data collection, the next step is to analyze the oil and gas reserves from the 25 top companies across nine years. Since the goal is to compare the total reported reserves by these 25 companies with the world total estimated reserves, the analysis will focus on total reserves per year, overlooking the reason of their variations.

Firstly, the year-end reserves of the 25 top companies have to be summed. When doing this, some problems come up. Concerning the oil reserves, which should be measured in MMbbl (millions of barrels), there are three types of problems: the information of Rosneft and Gazprom's reserves for 2003 and 2004, and Gaz de France's reserves from 2008 to 2011 is not available; in 2003 and 2004 Gazprom only reported the sum of their proved and probable

reserves or accordingly to the Russian reserves system, so we cannot take into account because it is not available only the volume of proved reserves; and NorskHydro report their oil reserves in millions of boe (barrel of oil equivalent), which makes it impossible to convert the values into millions of barrels, given the lack of information on the density of the oil. Thus, NorskHydro had to be excluded. Gazprom report its oil reserves in million tons but give in its annual report a conversion table to million barrels (1 ton oil = 7.33 barrels). In terms of the natural gas reserves, whose values should be in bcf (billions of cubic feet)[36], there are also some problems. Once again, Rosneft and Gazprom's reserves for 2003 and 2004, and Gaz de France's reserves from 2008 to 2011 are not available. Additionally, Rosneft, Gazprom and Gaz de France do not report their natural gas reserves in bcf. Gaz de France's natural gas reserves must therefore be excluded, since they are measured in mbep (millions of barrels equivalent petroleum). In case of natural gas reserves of Rosneft and Gazprom, since they are expressed in bcm, they can be converted into bcf (1bcf = 0.0283 bcm). It is important to notice that there are no NorskHydro reserves since 2007, because on October 2007, NorskHydro merged with Statoil, creating StatoilHydro. Once the adjustments are made, it is possible to add up. Table 4.2 and table 4.3 depict the results.

Having done this, these values must be compared with the world total oil and gas reserves estimates, which were obtained from a study made by BP named "BP Statistical Review of World Energy June 2012". Additionally, it is relevant to mention that natural gas reserves on the study were converted into bcf, since they were initially expressed in bcm.

The results obtained, which are represented in table 4.4, can represent different realities/conclusions. Looking at the 25 top oil reserves total, it only represents approximately 7% of the world total oil reserves estimates. Natural gas reality is not very different, with the 25 top natural gas reported reserves reaching around 15 of the world total natural gas estimates. It is essential to retain that, in both analyses; the total for 2003 and 2004 is smaller than for the other years, because Rosneft and Gazprom's reserves for these two years are missing.

[36] Throughout the document we are using the units' denominations and nomenclatures used in the reports.

**Table 4.2** Top Companies' Total Oil Reported Reserves

| | OIL (millions of barrels) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **2011** | **2010** | **2009** | **2008** | **2007** | **2006** | **2005** | **2004** | **2003** |
| Exxon | 10,113 | 9,418 | 9,215 | 7,576 | 7,744 | 8,194 | 7,813 | 8,395 | 9,889 |
| BP | 5,153 | 5,559 | 5,658 | 5,665 | 5,492 | 5,893 | 6,360 | 6,755 | 7,214 |
| Shell | 5,098 | 5,179 | 4,693 | 2,620 | 2,751 | 3,270 | 3,466 | 3,745 | 5,009 |
| Chevron | 4,295 | 4,270 | 4,610 | 4,735 | 4,665 | 5,294 | 5,626 | 5,511 | 6,280 |
| Total | 3,734 | 4,014 | 4,041 | 4,410 | 4,396 | 5,516 | 5,582 | 5,889 | 6,151 |
| Petrochina | 11,128 | 11,278 | 11,263 | 11,221 | 11,706 | 11,618 | 11,536 | 11,501 | 11,495 |
| Statoil | 2,181 | 2,023 | 2,070 | 2,074 | 2,389 | 2,423 | 2,614 | 1,721 | 1,789 |
| Eni | 3,134 | 3,415 | 3,377 | 3,243 | 3,127 | 3,457 | 3,748 | 3,972 | 4,138 |
| Petrobras | 10,783 | 10,731 | 10,269 | 9,106 | 9,547 | 9,418 | 9,716 | 9,945 | 9,772 |
| Conocophillips | 3,287 | 3,161 | 3,194 | 3,340 | 3,104 | 3,200 | 3,336 | 3,167 | 3,290 |
| LukOil | 13,123 | 13,025 | 13,383 | 14,242 | 15,492 | 15,593 | 15,774 | 15,516 | 15,573 |
| Marathon | 1,356 | 1,202 | 1,225 | 636 | 650 | 677 | 660 | 560 | 576 |
| Chinapetroleum | 2,848 | 2,889 | 2,919 | 2,961 | 3,024 | 3,295 | 3,294 | 3,267 | 3,257 |
| Rosneft | 18,351 | 18,110 | 18,058 | 17,694 | 17,513 | 15,963 | 14,877 | - | - |
| Gazprom | 5,306 | 5,259 | 5,267 | 5,228 | 5,329 | 5,050 | 3,876 | - | - |
| Occidental | 2,288 | 2,310 | 2,263 | 2,080 | 2,226 | 2,213 | 1,962 | 1,858 | 1,990 |
| Encana | 133 | 93 | 77 | 1,006 | 927 | 1,133 | 1,121 | 501 | 957 |
| Norsk hydro | - | - | - | - | - | - | - | - | - |
| Repsol | 978 | 908 | 883 | 903 | 952 | 1,059 | 1,167 | 1,582 | 1,768 |
| Gaz de france | - | - | - | - | 174 | 167 | 209 | 187 | 191 |
| BG | 1,105 | 946 | 736 | 688 | 506 | 552 | 572 | 635 | 645 |
| Imperial oil | 3,121 | 2,453 | 2,415 | 694 | 725 | 681 | 760 | 812 | 889 |
| Hess | 1,169 | 1,104 | 967 | 970 | 885 | 832 | 692 | 646 | 646 |
| CNOOC | 1,960 | 1,719 | 1,668 | 1,578 | 1,564 | 1,490 | 1,457 | 1,456 | 1,436 |
| OMV | 628 | 660 | 675 | 696 | 698 | 738 | 782 | 827 | 237 |
| **TOTAL** | **111,272** | **109,726** | **108,926** | **103,365** | **105,586** | **107,727** | **107,000** | **88,449** | **93,191** |

**Table 4.3.** Top Companies' Total Natural Gas Reported Reserves

| | NATURAL GAS (billions of cubic feet) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **2011** | **2010** | **2009** | **2008** | **2007** | **2006** | **2005** | **2004** | **2003** |
| Exxon | 45,375 | 46,813 | 34,442 | 31,402 | 32,610 | 32,480 | 33,355 | 31,843 | 33,395 |
| BP | 36,381 | 37,809 | 40,388 | 40,005 | 41,130 | 42,168 | 44,448 | 45,650 | 45,155 |
| Shell | 30,286 | 28,983 | 29,961 | 25,927 | 22,825 | 30,058 | 24,912 | 25,050 | 38,370 |
| Chevron | 25,229 | 20,755 | 22,153 | 19,022 | 19,137 | 19,910 | 20,466 | 16,128 | 17,553 |
| Total | 20,775 | 19,143 | 19,384 | 19,617 | 19,083 | 19,066 | 20,270 | 21,159 | 20,675 |
| Petrochina | 66,653 | 65,503 | 63,244 | 61,189 | 57,111 | 53,469 | 48,123 | 45,249 | 41,787 |
| Statoil | 17,681 | 17,965 | 18,148 | 18,984 | 20,319 | 20,696 | 20,987 | 14,415 | 13,886 |
| Eni | 15,582 | 16,198 | 16,262 | 17,214 | 16,549 | 16,897 | 17,501 | 18,278 | 18,008 |
| Petrobras | 12,381 | 11,894 | 10,988 | 12,139 | 12,469 | 11,766 | 12,352 | 11,247 | 11,202 |
| Conocophillips | 17,600 | 18,235 | 18,965 | 20,160 | 22,499 | 23,446 | 16,513 | 16,834 | 15,834 |
| LukOil | 22,922 | 23,340 | 22,564 | 29,079 | 27,747 | 26,404 | 25,100 | 24,385 | 24,307 |
| Marathon | 2,666 | 2,617 | 2,724 | 3,219 | 3,450 | 3,510 | 3,547 | 3,472 | 2,784 |
| Chinapetroleum | 6,709 | 6,447 | 6,739 | 6,959 | 6,331 | 2,857 | 2,952 | 3,033 | 2,888 |
| Rosneft | 30,017 | 27,934 | 28,817 | 27,687 | 25,109 | 24,756 | 24,402 | - | - |
| Gazprom | 678,512 | 670,697 | 657,227 | 642,320 | 645,806 | 642,313 | 566,896 | - | - |
| Occidental | 5,323 | 5,138 | 5,027 | 4,452 | 3,843 | 3,724 | 3,374 | 2,851 | 2,585 |
| Encana | 13,441 | 13,775 | 11,062 | 13,678 | 13,300 | 12,418 | 11,784 | 10,460 | 8,411 |
| Norsk hydro | - | - | - | - | - | 6,611 | 6,761 | 6,626 | 7,317 |
| Repsol | 6,747 | 6,643 | 6,744 | 7,341 | 8,156 | 8,718 | 12,137 | 14,342 | 15,447 |
| Gaz de france | - | - | - | - | - | - | - | - | - |
| BG | 12,854 | 11,685 | 11,181 | 10,623 | 9,196 | 9,582 | 9,667 | 9,076 | 8,758 |
| Imperial oil | 422 | 576 | 590 | 593 | 622 | 673 | 765 | 880 | 1,023 |
| Hess | 2,423 | 2,598 | 2,821 | 2,773 | 2,668 | 2,466 | 2,406 | 2,400 | 2,332 |
| CNOOC | 5,636 | 5,945 | 5,944 | 5,623 | 6,223 | 6,232 | 5,431 | 4,647 | 4,154 |
| OMV | 2,797 | 2,727 | 2,846 | 2,825 | 2,878 | 3,071 | 3,247 | 3,493 | 1,039 |
| **TOTAL** | **1,078,412** | **1,063,419** | **1,038,221** | **1,022,832** | **1,019,061** | **1,023,291** | **937,396** | **331,517** | **336,910** |

**Table 4.4** Top 25' Total Proved Reserves versus World Total Estimated[37]

| | **2011** | | **2010** | | **2009** | | **2008** | | **2007** | | **2006** | | **2005** | | **2004** | | **2003** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Vol.** | **%** | **Vol.** | **%** | **Vol.** | **%** | **Vol.** | **%** | **Vol.** | **%** | **Vol.** | **%** | **Vol.** | **%** | **Vol.** | **%** | **Vol.** | **%** |
| **Oil (Thousand million barrels)** | | | | | | | | | | | | | | | | | | |
| **Top 25** | 111 | 7 | 110 | 7 | 109 | 7 | 103 | 7 | 106 | 8 | 108 | 8 | 107 | 8 | 88 | 7 | 93 | 7 |
| **World Estimated** | 1,653 | | 1,622 | | 1,518 | | 1,475 | | 1,405 | | 1,365 | | 1,357 | | 1,346 | | 1,340 | |
| **Natural Gas (Trillion cubic meters)** | | | | | | | | | | | | | | | | | | |
| **Top 25** | 1,078 | 15 | 1,063 | 15 | 1,038 | 16 | 1,023 | 16 | 1,019 | 16 | 1,023 | 17 | 937 | 15 | 332 | 5 | 337 | 6 |
| **World Estimated** | 7,361 | | 6,926 | | 6,616 | | 6,535 | | 6,235 | | 6,117 | | 6,084 | | 6,067 | | 6,049 | |

[37] BP Statistical Review of World Energy, June 2012. Available at: http://www.bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2012.pdf

Since the sample is composed by 25 companies and Middle East companies are not taken into account, it is clear that the sample is too small to allow taking conclusions and therefore cannot really represent the existing reserves. However, at the same time, it can also be viewed as a good sample, since it includes the top companies of the world in oil and gas industry, who own substantially more oil and gas reserves, than the companies placed in the bottom positions of the ranking. For this reason, it does not make sense to believe that the 25 top companies only own 7% of oil reserves in the world.

Thus, this suggests that companies sub-estimate their reserves, reporting smaller amounts of reserves than what they actually own. However, there is a large part of world reserves that do not have available data for analysis – for instance, the Middle East reserves which represent, in 2011, 48% of the total world oil reserves and 38% of the total world gas reserves (BP Statistical Review, 2012).

When analyzing deeply the natural gas reserves which are represented in table 4.3, it can be confirmed that the total reserves of all years are influenced by Gazprom natural gas reserves. For example, Gazprom natural gas reserves are approximately 60% of the total, making this case worth noting. There are five possible interpretations for these values:

1. Since it derives from a conversion of bcm into bcf, there may be an error in the conversion process or a misinterpretation of the units;
2. Gazprom is overestimating their natural gas reserves, in other words, they are reporting a lot more reserves than those they own;
3. Gazprom is telling the truth and it owns the biggest quantity of reserves;
4. Gazprom reports their real reserves but the other companies are sub-estimating;
5. A combination of the previous reasons.

Most of Gazprom's reserves are in Russia, reportedly the country with the largest natural gas reserves, even exceeding the Middle-East reserves. Any of these explanations are plausible explanations for these numbers.

In order to improve the analysis, the year-end reserves of the 25 top companies were grouped by region at table 4.5. This will allow verifying in which regions are placed with more

significance the oil and gas reserves and if it is aligned with the study made by BP which are pictured in table 4.6.

Some of the 25 top companies split the total of oil and gas reserves in regions/countries, depending on where they are placed. So, taking advantage of that information, the reserves of 25 companies were carefully joined by region and by year. Having done this, to simplify and turn the analysis easier, they were summed according to the group of countries/continents, which are: North America, Central & South America, Africa, Eurasia, Asia & Oceana, Europe and Others. The percentage of reserves in different regions differs a lot from the one showed in "BP Statistical Review". However, the comparison proposed has some barriers/limitations. On the one hand, there is a strong lack of information on Middle East reserves. Not only do Middle East oil and gas companies not make available their reserves data, but also the 25 top companies do not separate their Middle East reserves (when they own) from the others. Due to the fact that Middle East reserves represent around 50% of world total, as it was already mentioned, it is an inaccuracy not considering them in the analysis. On the other hand, since lots of companies do not have reported reserves by region, it becomes harder to make the analysis, because all those reserves are classified as "others" when summed by region. Therefore, the major part of reserves are in "others". For instance, in 2011, the "others" oil reserves represents 51% of the total, and in 2007/2009, natural gas reserves of "others" achieves 78% of the total.

As a consequence of these limitations the information is scanty and makes it impossible to derive any accurate conclusions.

According to "BP Statistical Review", from 2003 to 2011, the areas with more oil reserves are Middle East and America by order of magnitude. By looking at (top companies reserves by region) table 4.5, if the "others" category is overlooked, America and Eurasia correspond to the biggest percentage of oil reserves. The gas reserves of top companies are equally distributed (excluding "others") by all regions which contrast with total gas reserves estimated by BP' study in which Middle East and Europe & Eurasia are the regions with more gas reserves.

By looking at each company, the reserves' evolution can be analyzed. In oil reserves, most companies present their reserves decreasing from 2003 until 2008, as is the case of BP, Chevron, Total, Lukoil, Chinapetroleum, Repsol and OMV. However, in some companies

like Exxon, Shell, Petrobras, Imperial Oil and BG, the oil reserves diminished until 2007/2008 but from 2009 onwards they showed a significant rise. This can be explained because since 2009, the reserves estimation and disclosure requirements changed according to the "modernization of oil and gas reporting" release. Those companies also started to report their synthetic oil and bitumen separately. Few companies have oil reserves positive growth from 2003 to 2011, for example, Rosneft, Occidental Petroleum, Hess, CNOOC and Marathon. Hence, oil reserves of CNOOC and Marathon increased even more in 2009, when the modification made on SFAS 69 became effective, as it mentioned before. In what concerns natural gas reserves, contrasting with oil reserves reality, the majority of companies are increasing their reported reserves. This is the case of Exxon, Shell, Chevron, Petrochina, Chinapetroleum, Rosneft, Gazprom, Occidental Petroleum, Encana and BG. A few companies present a declining value of their natural gas reserves, such as BP, ENI, Repsol and Imperial Oil. Petrochina is a good example of a positive growth in natural gas reserves, which is explained by extensions and discoveries made. Moreover, OMV also achieves an enormous increase in its oil and gas reserves in 2004 due to the purchase of reserves placed in Petrom. It is curious that most of companies that have a positive growth in their oil reserves also have in their natural gas reserves.

**Table 4.5** Top Companies' Proved Reserves by Region

| Proved Oil Reserves (millions of barrels) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2010 | | 2009 | | 2008 | | 2007 | | 2006 | | 2005 | | 2004 | | 2003 | |
| | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % |
| **North America** | 9,159 | 8 | 9,025 | 8 | 8,435 | 8 | 10,155 | 10 | 13,401 | 13 | 14,283 | 13 | 14,585 | 14 | 13,409 | 15 | 15,740 | 17 |
| **Central & South America** | 11,506 | 10 | 11,402 | 10 | 10,926 | 10 | 9,818 | 9 | 10,122 | 10 | 10,104 | 9 | 10,274 | 10 | 10,891 | 12 | 10,987 | 12 |
| **Africa** | 9,054 | 8 | 9,949 | 9 | 10,165 | 9 | 10,302 | 10 | 10,295 | 10 | 11,107 | 10 | 11,417 | 11 | 12,075 | 14 | 13,037 | 14 |
| **Eurasia** | 13,770 | 12 | 13,897 | 13 | 14,272 | 13 | 15,190 | 15 | 16,969 | 16 | 18,065 | 17 | 18,077 | 17 | 17,799 | 20 | 17,419 | 19 |
| **Asia & Oceania** | 5,594 | 5 | 6,446 | 6 | 6,392 | 6 | 6,775 | 7 | 4,382 | 4 | 3,731 | 3 | 4,471 | 4 | 4,563 | 5 | 4,988 | 5 |
| **Europe** | 5,769 | 5 | 5,452 | 5 | 5,417 | 5 | 5,531 | 5 | 7,105 | 7 | 7,571 | 7 | 8,441 | 8 | 8,157 | 9 | 8,478 | 9 |
| **Others** | 56,420 | 51 | 53,556 | 49 | 53,318 | 49 | 45,595 | 44 | 43,311 | 41 | 42,867 | 40 | 39,735 | 37 | 21,554 | 24 | 22,543 | 24 |
| **TOTAL** | **111,272** | | **109,726** | | **108,926** | | **103,365** | | **105,586** | | **107,727** | | **107,000** | | **88,449** | | **93,191** | |
| **Proved Natural Gas Reserves (billions of cubic feet)** | | | | | | | | | | | | | | | | | | |
| | 2011 | | 2010 | | 2009 | | 2008 | | 2007 | | 2006 | | 2005 | | 2004 | | 2003 | |
| | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % |
| **North America** | 75,958 | 7 | 73,979 | 7 | 56,817 | 5 | 60,470 | 6 | 86,913 | 9 | 86,801 | 8 | 82,952 | 9 | 78,641 | 24 | 79,360 | 24 |
| **Central & South America** | 18,867 | 2 | 18,390 | 2 | 17,566 | 2 | 19,209 | 2 | 18,318 | 2 | 18,148 | 2 | 21,238 | 2 | 22,048 | 7 | 23,198 | 7 |
| **Africa** | 23,629 | 2 | 24,341 | 2 | 24,112 | 2 | 22,785 | 2 | 25,453 | 2 | 26,025 | 3 | 26,156 | 3 | 25,817 | 8 | 22,359 | 7 |
| **Eurasia** | 20,746 | 2 | 21,307 | 2 | 20,994 | 2 | 27,443 | 3 | 32,065 | 3 | 38,471 | 4 | 31,394 | 3 | 29,497 | 9 | 26,249 | 8 |
| **Asia & Oceania** | 63,786 | 6 | 59,329 | 6 | 63,822 | 6 | 53,721 | 5 | 40,875 | 4 | 41,326 | 4 | 45,203 | 5 | 42,139 | 13 | 41,369 | 12 |
| **Europe** | 39,969 | 4 | 40,806 | 4 | 42,097 | 4 | 44,632 | 4 | 50,809 | 5 | 58,996 | 6 | 63,481 | 7 | 60,465 | 18 | 75,677 | 22 |
| **Others** | 835,458 | 77 | 825,268 | 78 | 812,814 | 78 | 794,573 | 78 | 764,627 | 75 | 753,524 | 74 | 666,972 | 71 | 72,911 | 22 | 68,698 | 20 |
| **TOTAL** | **1,078,412** | | **1,063,419** | | **1,038,221** | | **1,022,832** | | **1,019,061** | | **1,023,291** | | **937,396** | | **331,517** | | **336,910** | |

**Table 4.6** World Total Reserves Estimates (source: BP Statistical Review)

| Proved Oil Reserves (billions of barrels) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2010 | | 2009 | | 2008 | | 2007 | | 2006 | | 2005 | | 2004 | | 2003 | |
| | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % |
| **North America** | 217 | 13 | 218 | 13 | 219 | 14 | 217 | 15 | 221 | 16 | 222 | 16 | 224 | 17 | 224 | 17 | 226 | 17 |
| **Central & South America** | 325 | 20 | 325 | 20 | 238 | 16 | 199 | 13 | 124 | 9 | 111 | 8 | 103 | 8 | 103 | 8 | 100 | 7 |
| **Africa** | 132 | 8 | 133 | 8 | 130 | 9 | 128 | 9 | 127 | 9 | 119 | 9 | 118 | 9 | 114 | 8 | 112 | 8 |
| **Europe & Eurasia** | 141 | 9 | 139 | 9 | 137 | 9 | 136 | 9 | 138 | 10 | 115 | 8 | 116 | 9 | 114 | 9 | 116 | 9 |
| **Middle East** | 795 | 48 | 766 | 47 | 753 | 50 | 754 | 51 | 755 | 54 | 756 | 55 | 756 | 56 | 750 | 56 | 746 | 56 |
| **Asia Pacific** | 41 | 2 | 42 | 3 | 42 | 3 | 42 | 3 | 40 | 3 | 41 | 3 | 41 | 3 | 41 | 3 | 40 | 3 |
| **TOTAL** | **1,653** | | **1,622** | | **1,518** | | **1,475** | | **1,405** | | **1,365** | | **1,357** | | **1,346** | | **1,340** | |
| **Proved Natural Gas Reserves (trillions of cubic feet)** | | | | | | | | | | | | | | | | | | |
| | 2011 | | 2010 | | 2009 | | 2008 | | 2007 | | 2006 | | 2005 | | 2004 | | 2003 | |
| | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % | Volume | % |
| **North America** | 382 | 5 | 365 | 5 | 346 | 5 | 319 | 5 | 309 | 5 | 283 | 5 | 276 | 5 | 264 | 4 | 261 | 4 |
| **Central & South America** | 268 | 4 | 264 | 4 | 263 | 4 | 262 | 4 | 260 | 4 | 256 | 4 | 242 | 4 | 246 | 4 | 241 | 4 |
| **Africa** | 513 | 7 | 513 | 7 | 520 | 8 | 518 | 8 | 516 | 8 | 508 | 8 | 497 | 8 | 501 | 8 | 489 | 8 |
| **Europe & Eurasia** | 2,779 | 38 | 2,401 | 35 | 2,224 | 34 | 2,201 | 34 | 2,013 | 32 | 2,015 | 33 | 2,022 | 33 | 2,026 | 33 | 2,040 | 34 |
| **Middle East** | 2,826 | 38 | 2,803 | 40 | 2,682 | 41 | 2,664 | 41 | 2,620 | 42 | 2,569 | 42 | 2,571 | 42 | 2,555 | 42 | 2,555 | 42 |
| **Asia Pacific** | 592 | 8 | 581 | 8 | 580 | 9 | 572 | 9 | 517 | 8 | 487 | 8 | 476 | 8 | 475 | 8 | 462 | 8 |
| **TOTAL** | **7,361** | | **6,926** | | **6,616** | | **6,535** | | **6,235** | | **6,117** | | **6,084** | | **6,067** | | **6,049** | |

# CHAPTER 5:

# DISCUSSION

In this chapter, the results are discussed and the research questions will be addressed.

The previous analysis demonstrated that the total oil and gas reported reserves by the 25 top companies is smaller than the world total estimated oil and gas reserves, 7% and 15% respectively. Possible explanations for this outcome may be:

- The majority the larger of companies is underestimating their oil and gas reserves, while the smaller companies, not considered in the analysis, are overestimating their reserves.
- We are missing the larger reserves in the World, as the values for the Middle Eastern reserves are not disclosed ever, which clearly hinders our ability to draw any conclusive explanation.

In our opinion, it does not make sense that the reserves of the biggest 25 oil and gas companies in the world (even excluding Middle-East companies) represent such a low percentage of world reserves estimations. This is enhanced by the fact that the oil and gas industry is characterized for having a high level of concentration, which means that few companies own or control large part of the reserves.

Moreover, it suggests that oil and gas companies possibly have agreements with Middle-Eastern companies, which do not have much available information, and are, consequently, supporting them in hiding important information as well.

Another alternative to explain the results is that the total world reserves could be overestimated. However, since peak oil is also based on those values, the reserves estimation rather than being overestimated, should be considered as conservative, meaning that estimations are likely lower than the real values. This would lead to the reported reserves by top oil and gas companies constituting a superior percentage of conservative or pessimist values.

In "Global oil & gas depletion: an overview" Bentley[38] noticed that when looking at proved and probable reserves a *"general commercial tendency to be under-reported in large fields and over-reported in small"* is shown. The analogy with "price makers" and "price takers" can be applied. The first ones are oil companies that report less than they actually own (under-reported) because they have large oil reserves but want to enhance the oil as a scarce resource, therefore, increasing oil price. The last ones report more than they actually own (over-reported) because they want to take advantage of a more solid image.

Adding all these reasons to the fact that the accounting rule is not rigid enough, while allowing noise and giving room for companies' strategic factors influence the reserves disclosure, it can be concluded that total estimation of oil and gas reserves in the world cannot be calculated summing up the reported reserves by top oil and gas companies.

Although accounting rules are improving and trying to offer better definitions and disclosures requirements, the reporting of oil and gas reserves is still one step behind of the desired veracity. Even with the modernization of rules, that promoted an increase of oil reserves reported by top oil companies as analyzed in previous chapter, they still allow noise in oil and gas reporting. They have neither started requiring an audit/independent third entity to review reserves, nor have they defined a common price to be used in reserves' valuation (they simply revise how to calculate the price). The new changes to the accounting rule are not giving enough incentives for the oil and natural gas companies to disclose the reserves they actually own. This is also justified by the fact that SEC asks for companies' opinion and since it wants to collaborate with them, the change tends to become minimal. Through the analysis of comments about concept and propose release, it was clear in some topics that there are companies much tougher than others willing to disclose more information about themselves and wanting to get more information about their competitors. In the oil and natural gas industry, the information is a surplus value.

The ultimate incentive that oil and gas companies have in reserves disclosure is their profit. Therefore, in most cases, two different types of strategies can be identified. The first strategy adopted is when barrel price is low, companies seem to put a "social curtain" in order to transmit that they have few reserves. Hence, they have an incentive to report less oil reserves arguing that it is not economic viable to extract it, which means that, since the oil price is so

[38] Bentley, R.W. (2002). Global oil & gas depletion: an overview. Energy Policy, 30, 189–205

low, it does not compensate the extraction costs because it would yield lower margins. The second one is when barrel price is high, for instance in 2007, and companies take off the "social curtain". In this case, oil companies have the incentive to report more oil reserves and extract them because the high oil price will allow companies to achieve better margins. Generally, when oil price is increasing, it is likely that oil companies will declare that they have found more reserves in a new or an old field. The announcement enhances their value and companies usually get a better stock market position.

Taking into consideration that oil price is a result of many factors, which include the investors' expectations, and that the peak of oil theory is frequently recalled, the oil companies' behavior is described like a cycle as follows. Since the press communicated there was a possibility of oil running out sooner than it was expected, the fear among customers was installed, rising the oil demand, making the oil price increase. When the oil price is high, oil companies have an incentive to report more oil reserves, making higher profit. By showing that there are large oil reserves, the fear of oil shortage disappears, and consequently, oil demand decreases and the oil price diminishes. Therefore, oil companies have an incentive to put a "social curtain" arguing that extraction is not economic viable and the cycle begins once again.

One way to compare how reserves are valued from inside of company and outside is looking at capitalized costs and multiplication between quantity of barrels and the market price, respectively. There is no necessary correlation between them. Capitalized costs are all costs associated to acquiring properties, drilling and exploit wells, development of fields, equipment and facilities used in oil and gas activities. Thus, each company depending on the costs associated to their proved or unproved reserves will generate capitalized costs which will also reflect the investment made on those reserves. Otherwise, the quantity of barrels multiplied by the oil price will give an external point of view of the reserves' value. This result should be viewed as how much are consumers willing to pay for a determined number of barrels or how does market value a barrel. While oil price has high variation, mainly in latest years, so it will have a daily result; capitalized costs can be seen as medium/long-term costs that initially are capitalized independently of finding or not proved reserves. Therefore, the best scenario for oil companies is high barrel price and low capitalized costs. They cannot be compared since they represent two distinct points of views.

The caveats of analysis to note are mainly related to the data used. Although the analysis is based on top oil and gas companies, it does not take into account oil and gas companies of the Middle East, which are the largest ones, having so much power that they end up acting as a cartel. The comparison between the oil and gas reported reserves by companies in their annual report and the total world reserves is only made across nine years. Finally, it is assumed that the 25 top oil and gas companies are representative of the industry, which means that they have the largest market shares (excluding Middle East companies).

# CHAPTER 6:

# CONCLUSIONS AND IMPLICATIONS

In the oil industry, disclosed information has large implications on companies' results. The importance and influence of the accounting rule – SFAS 69 – followed by oil and gas companies in reporting their reserves, was the main issue studied in this thesis.

The comparison between the quantity of reserves reported by the top oil and gas companies included in the collected sample and the world total estimated reserves, allowed us to conclude that oil and gas companies are under-reporting their reserves.

The current accounting rule is not enough of an incentive for companies to report the actual reserves they own. Additionally, when the rule was changed, SEC asked for oil and gas companies to give their opinion on a few criteria they were proposing to modify, in an effort to try to align the goals of those companies with the amendments made. This supports the idea of cooperating with companies and taking into account their goals, rather than simply defining strict rules with the sole purpose of reporting the real reserves with the least subjectivity possible.

As expected, the heavy changes proposed will not be fully implemented, since no consensus was reached among oil and gas companies. For instance, no audits or reserves review made by a third party will be required. Instead, companies will only have to disclose and describe the internal controls, as well as the qualifications of the technical person. This means companies will still have internal control over their reserves estimations. Even though estimating the reserves is a complex and continuous process, it is also one which is based on judgments. It is, thus, obvious that the new rule still gives companies some freedom in their disclosing of reported reserves.

Even though, these changes try to improve the quality of the data reported by companies, several adjustments still have to be made so that oil and gas companies reported reserves actually reflect what the companies really own. According to the new rule, reserves' valuation will be calculated using the annual average of oil price, which is better than the last day of the year price, as it reduces volatility and protects against abnormal prices on that particular day.

In periods where volatility is actually relevant and should not be overseen, the new rule would lose this effect. Whatever price the rule would pick some information or characteristics would be inevitably missed.

SEC should, therefore, throughout the accounting rule, seek for compromises and keep promoting best practices in oil industry, improving the quality of oil and gas reserves data.

Having concluded this thesis, we believe that it would also be interesting to analyze the number of reported reserves of each top company, according to their opinion on new SFAS 69 (concept and proposing release). This would allow to categorize companies and define a profile (for instance, tough or liberal), depending on the quantity of reserves reported. The influence of oil price on the quantity of reserves reported on a monthly basis also strikes us as a curious study. Moreover, the analysis of the difference between the information quality and quantity of reported reserves by companies before and after January, when the new FAS 69 was issued, could be a pertinent additional study as well.

## REFERENCES


- Adelman, M.A. (1993). Modelling world oil supply. *The Energy Journal, 31,* 101–122.
- Adelman, M.A. (2004). The Real Oil Problem.
- Balsdon, E. & Deacon, R. T. (2004). Economics of exhaustible resources. *International Encyclopedia of the Social & Behavioral Sciences,* 5051-5058.
- Bentley, R.W. (2002). Global oil & gas depletion: an overview. *Energy Policy, 30,* 189–205.
- EIA (2007). "Energy Information Administration - U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2007 Annual Report".
- Environmental Accounts branch - Office for National Statistics, 1999. Retrieved from: http://unstats.un.org/unsd/envaccounting/ceea/archive/Energy/UK_Oil%20and%20gas%20reserves%20valuation.PDF
- Farzin, Y.H. (2001). The impact of oil price on additions to US proven reserves. *Resource and Energy Economics, 23 (3),* 271–292.
- FASB (1982). Statement of Financial Accounting Standards No. 69 – Disclosures about oil and gas producing activities. Retrieved from http://72.3.243.42/pdf/aop_FAS69.pdf
- Fishelson, G. (1983). Hotelling rule, economic responses and oil prices. *Energy Economics, 5 (3),* 153-156.
- Harrell, R. (2008). Whose reserves estimates can I trust?. *World Energy Magazine, 7(1).* Retrieved from http://www.worldenergysource.com/articles/text/harrell_WE_v7n1.cfm
- Hotelling, H. (1931). The Economics of Exhaustible Resources. *The Journal of Political Economy, 39 (2),* 137-175.
- Houthakker, H. S. (1976). *The world price of oil – a medium-term analysis.* American Enterprise Institute for Public Policy Research
- Hubbert, M. K. (1956). Nuclear Energy and the Fossil Fuels. *Drilling and Production Practice, 95,* 22-27. Available at http://www.hubbertpeak.com/hubbert/1956/1956.pdf

- Khanna, N. (2001). On the Economics of non-renewable resources, Economics interactions with other disciplines – Vol.II. Available at http://www.eolss.net/Sample-Chapters/C13/E6-29-03-01.pdf
- Laherrere, J. (2001). Estimates of oil reserves. Retrieved from http://www.iiasa.ac.at/Research/ECS/IEW2001/pdffiles/Papers/Laherrere-long.pdf
- Lin, C. & Wagner, G. (2007). Steady-state growth in a Hotelling model of resource extraction. *Journal of Environmental Economics and Management, 54 (1),* 68–83.
- Pindyck, R.S. (1978). The optimal exploration and production of nonrenewable resources. *Journal of Political Economy, 86,* 841–861.
- Platts (2008), www.platts.com/top250/index.xml
- Schlumberger Information Solutions (2003). Oil and Gas Reserves Disclosure White Paper.
- Thompson, A. C. (2001). The Hotelling principle, backwardation of futures prices and the values of developed petroleum reserves — the production constraint hypothesis. *Resource and Energy Economics, 23 (2),* 133–156.
- Watkins, G.C. (2006). Oil scarcity: What have the past three decades revealed?. *Energy Policy, 34 (5),* 508–514.
- Yergin, D. (1991). *The Prize: the epic quest for oil, money, and power. New York: Simon & Schuster.*

Others:

- BP (2012), "BP Statistical Review of World Energy June 2012" (http://www.bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2012.pdf)
- Gaffney, Cline & Associates (2009). A review of the revised Securities and Exchange Commission (SEC), Oil and Gas Reserves Reporting Requirements.
- SEC (2009), "Modernization of oil and gas reporting; Final Rule" (http://www.sec.gov/rules/final/2008/33-8995.pdf)

- SEC (2007), "Concept Release" (www.sec.gov/comments/s7-29-07/s72907.shtml)
- SEC (2008), "Proposing Release" (www.sec.gov/comments/s7-15-08/s71508.shtml)
- SEC, "Rule 4-10 - Financial Accounting and Reporting for Oil and Gas Producing Activities Pursuant to the Federal Securities Laws and the Energy Policy and Conservation Act of 1975" (http://www.law.uc.edu/CCL/regS-X/SX4-10.html) or (http://www.sec.gov/divisions/corpfin/guidance/cfactfaq.htm#P279_57537)
- SPE (2005) – "Glossary of Terms Used in Petroleum Reserves/Resources Definitions" (http://www.spe.org/spe-site/spe/spe/industry/reserves/GlossaryPetroleumReserves-ResourcesDefinitions_2005.pdf)

Annual Reports:

- BG Group (http://www.bg-group.com/OnlineReports/downloads/BG061_ARA.pdf)
- BP (http://www.bp.com/extendedsectiongenericarticle.do?categoryId=9021605&contentId=7040949)
- Chevron (http://www.chevron.com/annualreport/2007/documents/pdf/Chevron2007AnnualReport_full.pdf) and (http://investor.chevron.com/phoenix.zhtml?c=130102&p=irol-reportsAnnual)
- China Petroleum (http://english.sinopec.com/download_center/reports/2007/20080406/download/AnnualReport2007.pdf)
- ConocoPhillips (http://www.conocophillips.com/NR/rdonlyres/3838234F-F20C-4BCE-AE8D-78DE29D67455/0/07RevisedARfinal.pdf)
- EnCana (http://www.encana.com/wcm/groups/internet/@p_www-ir/documents/web_content/p006234.pdf)
- ENI (http://www.eni.it/en_IT/investor-relation/investor_swf.page)
- Exxon Mobil (http://ir.exxonmobil.com/phoenix.zhtml?c=115024&p=irol-SECText&TEXT=aHR0cDovL2NjYm4uMTBrd2l6YXJkLmNvbS94bWwvZmlsaW5nLnhtbD9yZXBvPXRlbmsmaXBhZ2U9NTU1NDI2MCZhdHRhY2g9T04%3d)

- Gaz de France (http://www.gdfsuez.com/fileadmin/user_upload/pdf/gdf_registration_document_2007_1213350785.pdf)
- Gazprom (http://www.gazprom.com/documents/Annual_Eng_2007.pdf)
- Hess (http://media.corporate-ir.net/media_files/irol/10/101801/reports/2007AR/pdfs/HESSCORP10K_2007.pdf)
- Imperial Oil (http://www.imperialoil.ca/Canada-English/Files/Investors/2007_AR.pdf)
- Lukoil (http://www.lukoil.com/static_6_5id_218_.html)
- Marathon Oil (http://www.marathon.com/content/documents/investor_center/annual_reports/annual_report_2007_book.pdf)
- Norsk Hydro (http://www.hydro.com/upload/Documents/Reports/Annual%20reports/AnnualReportandForm20F2005.pdf)
- Occidental Petroleum (http://www.oxy.com/Investor%20Relations/annual_report.htm)
- OMV (http://www.omv.com/SecurityServlet/secure?cid=1207158078567&lang=en&swa_id=302502203258.67883&swa_site=wps.vp.com)
- ONGC (http://www.ongcindia.com/download/annual_report06_07.pdf)
- Petrobras Brasileiro (http://www2.petrobras.com.br/ri/spic/bco_arq/Form20F2007Ing.pdf)
- Petrochina (http://www.petrochina.com.cn/Ptr/Investor_Relations/Periodic_Reports/)
- Repsol (http://www.repsol.com/imagenes/es_en/Form%2020F%20Repsol%20YPF%202007_tcm11-476684.PDF)
- Rosneft Oil (http://www.rosneft.com/attach/0/58/80/a_report_2007_eng.pdf)
- Royal Dutch Shell (http://www.shell.com/static/investor/downloads/financial_information/reports/20f/2007_annual_report_20f_sec.pdf)

- StatoilHydro (http://www.statoilhydro.com/en/InvestorCentre/AnnualReport/2007/OurResults/Downloads/Annual_report_2007.pdf)
- Total (http://www.total.com/static/en/medias/topic2346/Total_2007_en_Form-20F.pdf)

# APPENDICES

**Table 2.1** Reserves' definitions

| Reserves | SEC 1978 | SPE/WPC 1997 | SEC 2008 |
|---|---|---|---|
| **Proved** | Proved oil and gas reserves are the estimated quantities of crude oil, natural gas, and natural gas liquids which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions, i.e., prices and costs as of the date the estimate is made. Prices include consideration of changes in existing prices provided only by contractual arrangements, but not on escalations based upon future conditions. | Proved reserves are those quantities of petroleum which, by analysis of geological and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from a given date forward, from known reservoirs and under current economic conditions, operating methods, and government regulations. Proved reserves can be categorized as developed or undeveloped. | Proved oil and gas reserves are those quantities of oil and gas, which, by analysis of geosciences and engineering data, can be estimated with reasonable certainty to be economically producible—from a given date forward, from known reservoirs, and under existing economic conditions, operating methods, and government regulations—prior to the time at which contracts providing the right to operate expire, unless evidence indicates that renewal is reasonably certain, regardless of whether deterministic or probabilistic methods are used for the estimation The project to extract the hydrocarbons must have commenced or the operator must be reasonably certain that it will commence the project within a reasonable time |
| **Unproved** | N/A | Unproved reserves are based on geologic and/or engineering data similar to that used in estimates of proved reserves; but technical, contractual, economic, or regulatory uncertainties preclude such reserves being classified as proved. Unproved reserves may be further classified as probable reserves and possible reserves. | N/A |

| Reserves | SEC 1978 | SPE/WPC 1997 | SEC 2008 |
|---|---|---|---|
| **Developed** | Proved developed oil and gas reserves are reserves that can be expected to be recovered through existing wells with existing equipment and operating methods. Additional oil and gas expected to be obtained through the application of fluid injection or other improved recovery techniques for supplementing the natural forces and mechanisms of primary recovery should be included as proved developed reserves only after testing by a pilot project or after the operation of an installed program has confirmed through production response that increased recovery will be achieved | Developed reserves are expected to be recovered from existing wells including reserves behind pipe. Improved recovery reserves are considered developed only after the necessary equipment has been installed, or when the costs to do so are relatively minor. Developed reserves may be sub-categorized as producing or non-producing. | Developed oil and gas reserves are reserves of any category that can be expected to be recovered:<br><br>- Through existing wells with existing equipment and operating methods or in which the cost of the required equipment is relatively minor compared to the cost of a new well; and<br><br>- Through installed extraction equipment and infrastructure operational at the time of the reserves estimate if the extraction is by means not involving a well |
| **Undeveloped** | Proved undeveloped oil and gas reserves are reserves that are expected to be recovered from new wells on undrilled acreage, or from existing wells where a relatively major expenditure is required for recompletion. Reserves on undrilled acreage shall be limited to those drilling units offsetting productive units that are reasonably certain of production when drilled. Proved reserves for other undrilled units can be claimed only where it can be demonstrated with certainty that there is continuity of production from the existing productive formation. | Undeveloped reserves are expected to be recovered:<br>(1) from new wells on undrilled acreage,<br>(2) from deepening existing wells to a different reservoir, or<br>(3) where a relatively large expenditure is required to (a) recomplete an existing well or (b) install production or transportation facilities for primary or improved recovery projects. | Undeveloped oil and gas reserves are reserves of any category that are expected to be recovered from new wells on undrilled acreage, or from existing wells where a relatively major expenditure is required for recompletion |

| Reserves | SEC 1978 | SPE/WPC 1997 | SEC 2008 |
|---|---|---|---|
| **Undeveloped (cont.)** | Under no circumstances should estimates for proved undeveloped reserves be attributable to any acreage for which an application of fluid injection or other improved recovery technique is contemplated, unless such techniques have been proved effective by actual tests in the area and in the same reservoir. | | |
| **Producing** | N/A | Reserves subcategorized as producing are expected to be recovered from completion intervals which are open and producing at the time of the estimate. Improved recovery reserves are considered producing only after the improved recovery project is in operation. | N/A |
| **Non-producing** | N/A | Reserves subcategorized as non-producing include shut-in and behind-pipe reserves. Shut-in reserves are expected to be recovered from<br>(1) completion intervals which are open at the time of the estimate but which have not started producing,<br>(2) wells which were shutin for market conditions or pipeline connections, or<br>(3) wells not capable of production for mechanical reasons. | N/A |

| Reserves | SEC 1978 | SPE/WPC 1997 | SEC 2008 |
|---|---|---|---|
| **Probable** | | Probable reserves are those unproved reserves which analysis of geological and engineering data suggests are more likely than not to be recoverable. In this context, when probabilistic methods are used, there should be at least a 50% probability that the quantities actually recovered will equal or exceed the sum of estimated proved plus probable reserves. | Probable reserves are those additional reserves that are less certain to be recovered than proved reserves but which, together with proved reserves, are as likely as not to be recovered. When deterministic methods are used, it is as likely as not that actual remaining quantities recovered will exceed the sum of estimated proved plus probable reserves. When probabilistic methods are used, there should be at least a 50% probability that the actual quantities recovered will equal or exceed the proved plus probable reserves estimates. |
| **Possible** | N/A | Possible reserves are those unproved reserves which analysis of geological and engineering data suggests are less likely to be recoverable than probable reserves. In this context, when probabilistic methods are used, there should be at least a 10% probability that the quantities actually recovered will equal or exceed the sum of estimated proved plus probable plus possible reserves. | Possible reserves are those additional reserves that are less certain to be recovered than probable reserves. When deterministic methods are used, the total quantities ultimately recovered from a project have a low probability of exceeding proved plus probable plus possible reserves. When probabilistic methods are used, there should be at least a 10% probability that the total quantities ultimately recovered will equal or exceed the proved plus probable plus possible reserves estimates. |

(Source: Gaffney, Cline & Associates (2009). A review of the revised Securities and Exchange Commission (SEC), Oil and Gas Reserves Reporting Requirements; and SPE (2005) – "Glossary of Terms Used in Petroleum Reserves/Resources Definitions"

**Table 4.5.1** Top Companies' Total Oil Reported Reserves by Region

| Oil - millions of barrels | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2010 | | 2009 | | 2008 | | 2007 | | 2006 | | 2005 | | 2004 | | 2003 | |
| | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % |
| **NORTH AMERICA** | **9,159** | **8** | **9,025** | **8** | **8,435** | **8** | **10,155** | **10** | **13,401** | **13** | **14,283** | **13** | **14,585** | **14** | **13,409** | **15** | **15,740** | **17** |
| United States | 5,945 | **5** | 5,996 | **5** | 5,465 | **5** | 5,465 | **5** | 7,508 | **7** | 7,514 | **7** | 7,924 | **7** | 8,178 | **9** | 8,619 | **9** |
| North America | 176 | **0** | 146 | **0** | 161 | **0** | 316 | **0** | 237 | **0** | 250 | **0** | 231 | **0** | 80 | **0** | 99 | **0** |
| Canada | 175 | **0** | 135 | **0** | 117 | **0** | 1,047 | **1** | 990 | **1** | 1,192 | **1** | 977 | **1** | 314 | **0** | 903 | **1** |
| Canada/South America | 118 | **0** | 163 | **0** | 172 | **0** | 812 | **1** | 939 | **1** | 1,395 | **1** | 1,283 | **1** | 627 | **1** | 1,194 | **1** |
| California | | **0** | | **0** | | **0** | | **0** | 860 | **1** | 926 | **1** | 965 | **1** | 1,011 | **1** | 1,051 | **1** |
| Gulf of Mexico | | **0** | | **0** | | **0** | | **0** | 307 | **0** | 325 | **0** | 333 | **0** | 294 | **0** | 435 | **0** |
| Alaska | 1,311 | **1** | 1,285 | **1** | 1,220 | **1** | 1,202 | **1** | 1,335 | **1** | 1,356 | **1** | 1,505 | **1** | 1,536 | **2** | 1,553 | **2** |
| Lower 48 | 698 | **1** | 649 | **1** | 685 | **1** | 726 | **1** | 308 | **0** | 295 | **0** | 170 | **0** | 170 | **0** | 186 | **0** |
| Atlantic basin | 9 | **0** | 10 | **0** | 10 | **0** | 13 | **0** | 14 | **0** | 15 | **0** | 18 | **0** | 11 | **0** | 10 | **0** |
| Other | 728 | **1** | 642 | **1** | 605 | **1** | 575 | **1** | 903 | **1** | 1,015 | **1** | 1,179 | **1** | 1,188 | **1** | 1,690 | **2** |
| **CENTRAL & SOUTH AMERICA** | **11,506** | **10** | **11,402** | **10** | **10,926** | **10** | **9,818** | **9** | **10,122** | **10** | **10,104** | **9** | **10,274** | **10** | **10,891** | **12** | **10,987** | **12** |
| Brazil | 10,411 | **9** | 10,379 | **9** | 9,919 | **9** | 8,716 | **8** | 9,139 | **9** | 9,002 | **8** | 9,034 | **8** | 9,243 | **10** | 9,051 | **10** |
| Argentina | 584 | **1** | 532 | **0** | 539 | **0** | 581 | **1** | 619 | **1** | 676 | **1** | 774 | **1** | 1,066 | **1** | 1,208 | **1** |
| Central/South America | 415 | **0** | 401 | **0** | 373 | **0** | 432 | **0** | 151 | **0** | 200 | **0** | 281 | **0** | 372 | **0** | 414 | **0** |
| Latin America | 96 | **0** | 90 | **0** | 95 | **0** | 89 | **0** | 214 | **0** | 226 | **0** | 50 | **0** | 67 | **0** | 152 | **0** |
| Ecuador | | **0** | | **0** | | **0** | | **0** | | **0** | | **0** | 135 | **0** | 143 | **0** | 162 | **0** |
| **AFRICA** | **9,054** | **8** | **9,949** | **9** | **10,165** | **9** | **10,302** | **10** | **10,295** | **10** | **11,107** | **10** | **11,417** | **11** | **12,075** | **14** | **13,037** | **14** |
| Africa | 6,875 | **6** | 7,551 | **7** | 7,792 | **7** | 8,102 | **8** | 7,972 | **8** | 8,562 | **8** | 8,779 | **8** | 9,460 | **11** | 10,268 | **11** |
| Middle East/Africa | 441 | **0** | 523 | **0** | 562 | **1** | 444 | **0** | 721 | **1** | 777 | **1** | 741 | **1** | 600 | **1** | 651 | **1** |
| North Africa | 1,068 | **1** | 1,125 | **1** | 1,041 | **1** | 973 | **1** | 878 | **1** | 982 | **1** | 961 | **1** | 967 | **1** | 1,080 | **1** |
| West Africa | 670 | **1** | 750 | **1** | 770 | **1** | 783 | **1** | 725 | **1** | 786 | **1** | 936 | **1** | 1,047 | **1** | 1,038 | **1** |

| Oil - million of barrels (cont.) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2010 | | 2009 | | 2008 | | 2007 | | 2006 | | 2005 | | 2004 | | 2003 | |
| | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % |
| **EURASIA** | **13,770** | **12** | **13,897** | **13** | **14,272** | **13** | **15,190** | **15** | **16,969** | **16** | **18,065** | **17** | **18,077** | **17** | **17,799** | **20** | **17,419** | **19** |
| Russia | 12,786 | **11** | 12,654 | **12** | 13,054 | **12** | 13,838 | **13** | 15,191 | **14** | 15,183 | **14** | 15,366 | **14** | 15,252 | **17** | 15,318 | **16** |
| Russia/Caspian | | **0** | | **0** | | **0** | | **0** | 117 | **0** | 907 | **1** | 897 | **1** | 905 | **1** | 850 | **1** |
| Kazakhstan | 653 | **1** | 788 | **1** | 849 | **1** | 911 | **1** | | **0** | | **0** | 43 | **0** | 45 | **0** | 49 | **0** |
| Caspian Area | | **0** | | **0** | | **0** | | **0** | 753 | **1** | 893 | **1** | 778 | **1** | 799 | **1** | | **0** |
| Middle East/Russia | 217 | **0** | 285 | **0** | 232 | **0** | 263 | **0** | 908 | **1** | 1,082 | **1** | 993 | **1** | 798 | **1** | 1,202 | **1** |
| Rest of Eurasia | 114 | **0** | 170 | **0** | 137 | **0** | 178 | **0** | | **0** | | **0** | | **0** | | **0** | | **0** |
| **ASIA & OCEANIA** | **5,594** | **5** | **6,446** | **6** | **6,392** | **6** | **6,775** | **7** | **4,382** | **4** | **3,731** | **3** | **4,471** | **4** | **4,563** | **5** | **4,988** | **5** |
| Asia Pacific/Middle East | 2,254 | **2** | 2,646 | **2** | 2,675 | **2** | 3,035 | **3** | 2,307 | **2** | 1,625 | **2** | 856 | **1** | 931 | **1** | 1,058 | **1** |
| Asia - Pacific | 1,104 | **1** | 1,493 | **1** | 1,231 | **1** | 1,069 | **1** | 1,283 | **1** | 1,401 | **1** | 1,441 | **1** | 1,326 | **1** | 1,526 | **2** |
| Indonesia | | **0** | | **0** | | **0** | | **0** | 439 | **0** | 576 | **1** | 579 | **1** | 698 | **1** | 807 | **1** |
| Asia | 1,707 | **2** | 1,820 | **2** | 1,965 | **2** | 2,252 | **2** | 119 | **0** | 107 | **0** | 117 | **0** | 145 | **0** | 158 | **0** |
| Bohai Bay | | **0** | | **0** | | **0** | | **0** | | **0** | | **0** | 920 | **1** | 975 | **1** | 990 | **1** |
| China Sea | | **0** | | **0** | | **0** | | **0** | | **0** | | **0** | 537 | **1** | 481 | **1** | 446 | **0** |
| Oceania | 194 | **0** | 95 | **0** | 103 | **0** | 89 | **0** | 21 | **0** | 21 | **0** | 21 | **0** | 8 | **0** | 3 | **0** |
| Australia | 335 | **0** | 392 | **0** | 418 | **0** | 330 | **0** | 213 | **0** | | **0** | | **0** | | **0** | | **0** |
| **EUROPE** | **5,769** | **5** | **5,452** | **5** | **5,417** | **5** | **5,531** | **5** | **7,105** | **7** | **7,571** | **7** | **8,441** | **8** | **8,157** | **9** | **8,478** | **9** |
| Europe | 3,535 | **3** | 3,344 | **3** | 3,177 | **3** | 3,281 | **3** | 3,506 | **3** | 3,767 | **3** | 4,302 | **4** | 4,637 | **5** | 5,074 | **5** |
| Norway | 1,369 | **1** | 1,241 | **1** | 1,351 | **1** | 1,396 | **1** | 1,696 | **2** | 1,760 | **2** | 1,923 | **2** | 1,150 | **1** | 1,243 | **1** |
| Italy | 259 | **0** | 248 | **0** | 233 | **0** | 186 | **0** | 215 | **0** | 215 | **0** | 228 | **0** | 225 | **0** | 252 | **0** |
| North Sea | | **0** | | **0** | | **0** | | **0** | 345 | **0** | 386 | **0** | 433 | **0** | 450 | **1** | 529 | **1** |
| United Kingdom | 165 | **0** | 151 | **0** | 172 | **0** | 159 | **0** | 728 | **1** | 796 | **1** | 871 | **1** | 969 | **1** | 1,261 | **1** |
| Spain | | **0** | | **0** | | **0** | | **0** | 3 | **0** | 3 | **0** | 3 | **0** | 4 | **0** | 5 | **0** |
| Germany | | **0** | | **0** | | **0** | | **0** | 48 | **0** | 43 | **0** | 47 | **0** | 45 | **0** | 50 | **0** |
| Netherlands | | **0** | | **0** | | **0** | | **0** | 1 | **0** | 1 | **0** | 1 | **0** | 1 | **0** | 1 | **0** |
| Austria | 47 | **0** | 48 | **0** | 51 | **0** | 51 | **0** | 56 | **0** | 56 | **0** | 55 | **0** | 60 | **0** | 63 | **0** |
| Romania | 395 | **0** | 419 | **0** | 434 | **0** | 457 | **0** | 508 | **0** | 544 | **1** | 578 | **1** | 617 | **1** | | **0** |
| **OTHERS** | **56,420** | **51** | **53,556** | **49** | **53,318** | **49** | **45,595** | **44** | **43,311** | **41** | **42,867** | **40** | **39,735** | **37** | **21,554** | **24** | **22,543** | **24** |
| **TOTAL** | **111,272** | **100** | **109,726** | **100** | **108,926** | **100** | **103,365** | **100** | **105,586** | **100** | **107,727** | **100** | **107,000** | **100** | **88,449** | **100** | **93,191** | **100** |

**Table 4.5.2** Top Companies' Total Natural Gas Reported Reserves by Region

| Natural Gas - bcf | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2010 | | 2009 | | 2008 | | 2007 | | 2006 | | 2005 | | 2004 | | 2003 | |
| | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % |
| **NORTH AMERICA** | **75,958** | **7** | **73,979** | **7** | **56,817** | **5** | **60,470** | **6** | **86,913** | **9** | **86,801** | **8** | **82,952** | **9** | **78,641** | **24** | **79,360** | **24** |
| United States | 44,527 | 4 | 42,673 | 4 | 26,282 | 3 | 27,665 | 3 | 40,972 | **4** | 38,895 | **4** | 40,835 | **4** | 37,616 | **11** | 36,184 | **11** |
| North America | 4,120 | 0 | 3,918 | 0 | 3,711 | 0 | 2,852 | 0 | 45 | **0** | 52 | **0** | 224 | **0** | 280 | **0** | 466 | **0** |
| Canada | 8,720 | 1 | 8,603 | 1 | 7,645 | 1 | 10,461 | 1 | 10,130 | **1** | 10,338 | **1** | 7,487 | **1** | 6,799 | **2** | 6,298 | **2** |
| Canada/South America | 835 | 0 | 1,258 | 0 | 1,368 | 0 | 1,383 | 0 | 1,559 | **0** | 1,984 | **0** | 2,324 | **0** | 1,883 | **1** | 2,341 | **1** |
| California | | 0 | | 0 | | 0 | | 0 | 317 | **0** | 310 | **0** | 304 | **0** | 314 | **0** | 323 | **0** |
| Gulf of Mexico | | 0 | | 0 | | 0 | | 0 | 943 | **0** | 1,094 | **0** | 1,171 | **0** | 1,064 | **0** | 1,841 | **1** |
| Alaska | 2,960 | 0 | 2,862 | 0 | 2,780 | 0 | 2,488 | 0 | 3,431 | **0** | 3,414 | **0** | 3,472 | **0** | 3,344 | **1** | 2,922 | **1** |
| Lower 48 | 7,188 | 1 | 7,617 | 1 | 7,962 | 1 | 8,423 | 1 | 9,203 | **1** | 9,027 | **1** | 4,114 | **0** | 4,234 | **1** | 4,258 | **1** |
| Atlantic basin | 4,402 | 0 | 4,237 | 0 | 4,330 | 0 | 4,135 | 0 | 4,562 | **0** | 4,615 | **0** | 4,547 | **0** | 4,472 | **1** | 4,167 | **1** |
| Other | 3,206 | 0 | 2,811 | 0 | 2,739 | 0 | 3,063 | 0 | 15,751 | **2** | 17,072 | **2** | 18,474 | **2** | 18,635 | **6** | 20,560 | **6** |
| **CENTRAL&SOUTH AMERICA** | **18,867** | **2** | **18,390** | **2** | **17,566** | **2** | **19,209** | **2** | **18,318** | **2** | **18,148** | **2** | **21,238** | **2** | **22,048** | **7** | **23,198** | **7** |
| Brazil | 11,067 | 1 | 10,554 | 1 | 9,859 | 1 | 9,346 | 1 | 10,078 | **1** | 9,427 | **1** | 9,264 | **1** | 7,954 | **2** | 8,111 | **2** |
| Argentina | 2,397 | 0 | 2,578 | 0 | 2,719 | 0 | 3,145 | 0 | 3,754 | **0** | 4,081 | **0** | 4,772 | **1** | 5,867 | **2** | 6,695 | **2** |
| Central/South America | 5,370 | 0 | 5,202 | 0 | 4,935 | 0 | 6,655 | 1 | 4,278 | **0** | 4,446 | **0** | 7,203 | **1** | 8,227 | **2** | 8,391 | **2** |
| Latin America | 33 | 0 | 56 | 0 | 53 | 0 | 63 | 0 | 208 | **0** | 194 | **0** | | **0** | | **0** | | **0** |
| Ecuador | | 0 | | 0 | | 0 | | 0 | | **0** | | **0** | | **0** | | **0** | | **0** |
| **AFRICA** | **23,629** | **2** | **24,341** | **2** | **24,112** | **2** | **22,785** | **2** | **25,453** | **2** | **26,025** | **3** | **26,156** | **3** | **25,817** | **8** | **22,359** | **7** |
| Africa | 13,382 | 1 | 13,828 | 1 | 13,763 | 1 | 13,042 | 1 | 15,480 | **2** | 15,792 | **2** | 15,809 | **2** | 15,546 | **5** | 13,084 | **4** |
| Middle East/Africa | 1,925 | 0 | 2,048 | 0 | 2,175 | 0 | 1,236 | 0 | 2,100 | **0** | 2,360 | **0** | 2,266 | **0** | 2,112 | **1** | 2,153 | **1** |
| North Africa | 6,373 | 1 | 6,338 | 1 | 6,047 | 1 | 6,423 | 1 | 5,751 | **1** | 5,946 | **1** | 6,117 | **1** | 6,432 | **2** | 5,467 | **2** |
| West Africa | 1,949 | 0 | 2,127 | 0 | 2,127 | 0 | 2,084 | 0 | 2,122 | **0** | 1,927 | **0** | 1,965 | **0** | 1,727 | **1** | 1,656 | **0** |

| Natural Gas – bcf (cont.) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2010 | | 2009 | | 2008 | | 2007 | | 2006 | | 2005 | | 2004 | | 2003 | |
| | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % | Vol. | % |
| **EURASIA** | **20,746** | **2** | **21,307** | **2** | **20,994** | **2** | **27,443** | **3** | **32,065** | **3** | **38,471** | **4** | **31,394** | **3** | **29,497** | **9** | **26,249** | **8** |
| Russia | 16,851 | 2 | 16,833 | 2 | 15,933 | 2 | 22,273 | 2 | 22,845 | **2** | 22,128 | **2** | 21,431 | **2** | 21,356 | **6** | 22,152 | **7** |
| Russia/Caspian | | 0 | | 0 | | 0 | | 0 | 98 | **0** | 887 | **0** | 950 | **0** | 634 | **0** | 469 | **0** |
| Kazakhstan | 1,648 | 0 | 1,874 | 0 | 2,139 | 0 | 2,437 | 0 | | **0** | | **0** | | **0** | | **0** | | **0** |
| Caspian Area | | 0 | | 0 | | 0 | | 0 | 1,770 | **0** | 1,874 | **0** | 1,774 | **0** | 2,124 | **1** | | **0** |
| Middle East/Russia | 1,637 | 0 | 1,965 | 0 | 2,175 | 0 | 1,906 | 0 | 7,352 | **1** | 13,582 | **1** | 7,239 | **1** | 5,383 | **2** | 3,628 | **1** |
| Rest of Eurasia | 610 | 0 | 635 | 0 | 747 | 0 | 827 | 0 | | **0** | | **0** | | **0** | | **0** | | **0** |
| **ASIA & OCEANA** | **63,786** | **6** | **59,329** | **6** | **63,822** | **6** | **53,721** | **5** | **40,875** | **4** | **41,326** | **4** | **45,203** | **5** | **42,139** | **13** | **41,369** | **12** |
| Asia Pacific/Middle East | 13,738 | 1 | 14,222 | 1 | 15,284 | 1 | 17,261 | 2 | 11,124 | **1** | 12,413 | **1** | 10,204 | **1** | 9,090 | **3** | 10,575 | **3** |
| Asia - Pacific | 10,691 | 1 | 11,970 | 1 | 13,733 | 1 | 13,556 | 1 | 23,970 | **2** | 24,535 | **2** | 24,772 | **3** | 23,024 | **7** | 20,733 | **6** |
| Indonesia | | 0 | | 0 | | 0 | | 0 | 485 | **0** | 574 | **0** | 646 | **0** | 502 | **0** | 520 | **0** |
| Asia | 15,342 | 1 | 13,874 | 1 | 15,096 | 1 | 15,663 | 2 | 3,435 | **0** | 3,703 | **0** | 4,057 | **0** | 4,742 | **1** | 5,309 | **2** |
| Bohai Bay | | 0 | | 0 | | 0 | | 0 | | **0** | | **0** | 741 | **0** | 706 | **0** | 567 | **0** |
| China Sea | | 0 | | 0 | | 0 | | 0 | | **0** | | **0** | 4,690 | **1** | 3,940 | **1** | 3,588 | **1** |
| Oceania | 6,420 | 1 | 5,312 | 0 | 5,449 | 1 | 2,652 | 0 | 104 | **0** | 101 | **0** | 93 | **0** | 134 | **0** | 78 | **0** |
| Australia | 17,595 | 2 | 13,951 | 1 | 14,260 | 1 | 4,589 | 0 | 1,757 | **0** | | **0** | | **0** | | **0** | | **0** |
| **EUROPE** | **39,969** | **4** | **40,806** | **4** | **42,097** | **4** | **44,632** | **4** | **50,809** | **5** | **58,996** | **6** | **63,481** | **7** | **60,465** | **18** | **75,677** | **22** |
| Europe | 18,359 | 2 | 18,459 | 2 | 18,979 | 2 | 20,610 | 2 | 21,071 | **2** | 21,800 | **2** | 24,564 | **3** | 27,296 | **8** | 42,870 | **13** |
| Norway | 15,688 | 1 | 16,343 | 2 | 16,938 | 2 | 17,581 | 2 | 18,893 | **2** | 25,558 | **2** | 26,166 | **3** | 19,604 | **6** | 20,651 | **6** |
| Italy | 2,491 | 0 | 2,644 | 0 | 2,704 | 0 | 2,844 | 0 | 3,057 | **0** | 3,391 | **0** | 3,676 | **0** | 3,818 | **1** | 4,166 | **1** |
| North Sea | | 0 | | 0 | | 0 | | 0 | 1,558 | **0** | 1,697 | **0** | 1,864 | **0** | 2,051 | **1** | 2,223 | **1** |
| United Kingdom | 936 | 0 | 862 | 0 | 930 | 0 | 1,020 | 0 | 3,626 | **0** | 3,861 | **0** | 4,410 | **0** | 4,720 | **1** | 5,233 | **2** |
| Spain | | 0 | | 0 | | 0 | | 0 | | **0** | | **0** | 1 | **0** | | **0** | | **0** |
| Austria | 382 | 0 | 415 | 0 | 444 | 0 | 494 | 0 | 521 | **0** | 544 | **0** | 572 | **0** | 530 | **0** | 534 | **0** |
| Romania | 2,113 | 0 | 2,084 | 0 | 2,102 | 0 | 2,083 | 0 | 2,084 | **0** | 2,144 | **0** | 2,228 | **0** | 2,446 | **1** | | **0** |
| **OTHERS** | **835,458** | **77** | **825,268** | **78** | **812,814** | **78** | **794,573** | **78** | **764,627** | **75** | **753,524** | **74** | **666,972** | **71** | **72,911** | **22** | **68,698** | **20** |
| **TOTAL** | **1,078,412** | **100** | **1,063,419** | **100** | **1,038,221** | **100** | **1,022,832** | **100** | **1,019,061** | **100** | **1,023,291** | **100** | **937,396** | **100** | **331,517** | **100** | **336,910** | **100** |