

**THE ROLE OF FEASIBILITY STUDIES
TO ENHANCE
THE NATURAL GAS INDUSTRY**

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ABSTRACT

The purpose of this paper is to shed some light on the key issues of the gas projects feasibility studies and to answer on this question "What is the impact of the economic, financial and marketing studies on the transmission and distribution gas project's feasibility studies in Egypt?"

One of the obstacles to a beneficial gas project developing is, undoubtedly, the lack of knowledge in developing countries of how to formulate a project in such a way that its potential profitability whether from a private or social viewpoint, can be estimated from as firm a basis as possible. While there has been some improvement in these areas, this is still broadly true. The basis for an efficient gas project should not only depend on technical and engineering skills, but also on sound **economic, marketing, financial and legal** studies and expertise. Along with these sophisticated studies, another difficult but equally important subject has to be deeply assessed, namely the element of risk. A common misperception in the feasibility studies domain is that some people think that it should only answer the question of whether the project is profitable or not, while its main goal is to explore the question of whether the project represents the best possible use of the limited (scarce) resources at the country's disposal (specialized manpower, capital, natural resources).

The starting point of any feasibility study of the gas projects is the market research. The concept of the market should be interpreted very widely. It should include the whole environment in which the gas project to live and to which it must adopt itself: consumers, suppliers, competitors and all kinds of technical material, political, legal and administrative restrictions. The gas projects can't operate unless it has been created for specific market, and once created it can't continue working unless it constantly adopts itself to the changing market in both case this pre supposes knowledge of the market.

The paper is covering market research and cost estimation, putting considerable emphasis on the need to probe alternative scales and techniques of operation. Once estimates of the value of inputs and outputs for the project's life have been made, profitability is assessed by the discounted cash flow method. The problem of selecting projects to fit limited budget and the preparation of financial, as well as physical, plan of operation is also discussed. Finally the difficult subject of risk is briefly dealt with.

The paper is discussing the role of feasibility study of the gas project which mainly deals with the future, our knowledge of the future, and sometimes even with the present is imperfect. Each decision taken now is the outcome of a set of assumptions concerning the future events (the gas price volatility, the fluctuation of the raw materials cost, emergence of new competitors, climatic uncertainties, political or social developments, human caprice and instability ... etc). This uncertainty is worsened by the fact that the forecast are based on an imperfect knowledge of economic conditions.

Introduction

The Egyptian petroleum sector plays a significant role to enhance Egypt economy. It constitutes one of four main sources of foreign currency. In the last decade, Egypt's petroleum sector started to shift substantially toward natural gas through adopting new strategy that encourage the economic viability of the gas projects and attract Foreign Direct Investment (FDI). The adopted strategy leads to enhance the proven gas reserves which reached around 62 TCF with a probable reserves of 120 TCF.

Interest in natural gas has increased steadily world wide in the last decade. The clean-burning properties of natural gas compared to other fossil fuels together with increasing concerns about air quality have attracted environmental interests. The full deregulation increased globalization of natural gas trade in recent years have attracted the interests of investors. Increased volatility of natural gas prices, including price spikes. Factors accelerate shifting toward natural gas can be concluded as follow:

- Growth in natural gas reserve
- Mergers and acquisitions.
- Natural gas production profit margin.
- Technological paradigm shift in natural gas industry leads to reduced costs.
- The differential in profitability of upstream natural gas production.

Oil and Gas projects have its unique five factors that are essentially to be understood to perform the economic feasibility study:

- i. The sector is very cash intensive and major projects involve substantial cash flows.
- ii. There is frequently a very long lead time between the initial expenditure and the resulting revenue.
- iii. Decisions are frequently made in an environment of high levels of uncertainty and risk.
- iv. The competition for funds for alternative projects can be substantial.
- v. The taxation and contract structure may be unique to the industry.

1. Gas financing demand:

Shifting towards natural gas is expected to require a tremendous financial capabilities in the Arab countries. According to recent study (1), the total expected investment in the Arab region for oil, gas, refinery and petrochemical sectors during the period from 2002-2006 are about 63 billion US dollars distributed as shown in table no.1. The majority of the required fund shall be direct for the development of Liquefied Natural gas projects, transmission and distribution pipeline projects and Liquefied Natural gas.

A venerable proposition in the field of economics is that capital will tend to flow to activities with higher expected rates of return, and

¹ - ايجكورت، "الإحصائيات لاستثمارية التوقمة لمطامعات البسط والغاز والصناعات البترو كيميائية في المنطقة العربية ومصادر تمويلها: العرض والتحديات". مؤتمر الطاقة العربي السابع، القاهرة، مصر، ١١-١٤ مايو ٢٠٠٢ ص ٢١

conversely, will tend to be withdrawn from activities with lower rates of return. This proposition is of sufficient generality that it should apply to the natural gas projects. The profitability of a project (Net Present Value) is often calculated by the Net Cash Flow which is the difference between the cash flow in and the cash flow out. If the difference is positive then the founder shareholders will examine the required return on investment taking into consideration the time value of money.

Table (1): the expected Arab gas projects financing demand during 2002-2006 (in millions)

Country	Oil	Gas	Refinery	Petrochemical	Total (ex. Oil)
Egypt		7600	600	2980	11180
U.A.Emirates	2100	3400	900	-	4300
Jordan		400	-	-	400
Bahrain		-	600	-	600
Algeria	3000	5050	-	2930	7980
Oman	200	980	870	2060	3910
Syria	5200	200	500	-	700
Saudi Arabia		5000	1500	5085	11585
Qatar	400	9390	400	2800	12590
Kuwait	900	-	126	3500	3626
Lebanon		-	300	-	300
Libya	4500	4500	550	400	5450
Morocco		-	500	-	500
Yemen	700	-	350	-	350
Iraq	3000				
Sudan	1100				
Total	21100	36420	7196	19755	63371
	0	0			

2. Gas projects chain of value

The first step in planning for a natural gas investment project to thoroughly understand the specific features and characteristics of the industry. The natural gas industry can be divided into four interrelated parts: exploration & development, production, transmission & distribution.

2.1. Exploration activities:

The exploration for natural gas typically begins with examining the surface structure of the earth, and determining areas where it is likely that petroleum or gas deposits might exist. The upstream margin is the applicable measure to evaluate the profitability of the oil or gas exploration at the wellhead. The upstream margin is defined as the price received at the wellhead for oil and natural gas produced less the costs of extracting oil and natural gas (termed, lifting costs) less the costs of replacing the oil and natural gas produced (termed, finding costs).

If the upstream margin is positive, then the wellhead price covers both production costs and the costs of replacing production as well as providing a positive return to current investments. If the margin is negative, then the costs of replacing production are not being fully covered. Companies in this latter position will have an incentive to reduce their reserve base and their production will tend to decline. In the direct situation when the wellhead price is below lifting costs, out-of-pocket expenses are not being covered and cessation of production

becomes a possibility. A surrogate measure of profitability that can be estimated for oil and natural gas separately is necessary.

Wellhead prices are one of the pricing system that encourage or discourage the exploration and development activities for oil and gas or making one of them more attractive versus the other one. If the upstream margin is more positive regarding the natural gas production compared to oil production, then one can expect more natural gas wells will be drilled. Wellhead price is volatile and risk associated is so high.

Another pricing system for upstream suppliers can be found in different countries relating the oil price to the produced natural gas such as linking natural gas price to Brent price. One of the advantage of that system is the upstream margin for oil and gas may be equal which encourage the exploration and development for both oil and gas and reduce risk profile for gas, while its disadvantage is the insularity of the gas projects (upstream, mid stream and down stream)

2.2. Natural gas processing and transmission

Natural gas, as it is used by consumers, is much different from the natural gas that is brought from underground up to the wellhead. Although the processing of natural gas is in many respects less complicated than the processing and refining of crude oil, it is equally as necessary before its use by end users.

2.2.1. Natural gas processing

Natural gas processing consists of separating all of the various hydrocarbons and fluids from the pure natural gas, to produce what is known as 'pipeline quality' dry natural gas. Major transportation pipelines usually impose restrictions on the make-up of the natural gas that is allowed into the pipeline. That means that before the natural gas can be transported it must be purified. While the ethane, propane, butane, and pentanes must be removed from natural gas, this does not mean that they are all 'waste products'.

Gas processing plant economy will depend on the wellhead price or the gas price related to oil price and the final product price such as the commercial propane, LPG, condensate, dry gas and other products price and cost of transportation and distribution to the end users.

2.2.2. Natural gas transmission

Constructing natural gas pipelines requires a great deal of planning and preparation. In addition to actually building the pipeline, several permitting and regulatory processes must be completed. In many cases, prior to beginning the permitting and land access processes, natural gas pipeline companies prepare a feasibility analysis to ensure that an acceptable route for the pipeline exists that provides the least impact to the environment and public infrastructure already in place (EIA Studies).

Natural gas transmission pipeline economy depends on the pipeline length, operability, maintainability, approachability, constructability and environmental friendliness which can be explained as follow:

- i. Pipeline length: this is the most crucial cost element because the cost of capital depend mostly on the length.
- ii. Operability: the pipeline is designed for specific throughput in line with demand; the pipeline may need to be augmented in the future to cope with the demand for maximizing profit.
- iii. Maintainability: the pipeline are designed with adequate safety factors.
- iv. Approachability: although the pipeline is buried underground, the right of way should allow uninterrupted construction activities, as well as operation, inspection and maintenance.
- v. Constructability: location characteristics are of a major cost component of pipeline construction economy.
- vi. Environmental issues: pipelines handle a hazardous products, although pipeline failure is not common, a pipeline located in a remote area is less safety concern.

2.2.3. Liquefied Natural gas

There is another way to transport the natural gas from a region to another which is the LNG (Liquefied Natural Gas). It is gas cooled to below -161°C , where it liquefies and can be stored as a boiling liquid in insulated tanks. LNG carried by specially built ships offers an alternative means of transportation to pipelines, and may be more

economic than pipelines particularly over long distances. Around 6% of world gas production is transported as LNG and 22 % of the transmitted gas.

LNG project economic evaluation shall be based on the LNG project structures that meet a range of objectives including, ensuring stability of operation, sharing risks and rewards equitably, satisfying the requirements of the host government, and minimizing the potential for conflict and delay. Project structures can be grouped into three generic models:

- i. **Integrated project:** an integrated project there is common ownership of the gas reserves, liquefaction plant, and in most cases the LNG ships. An integrated project has the advantages of aligning the partner interests and avoiding negotiation of transfer prices. There is a case study of the RasGas trains 1 and 2 integrated project. Integrated structure may not be possible in many situations because the owners of the gas reserves differ from the liquefaction plant owners. In these cases the most common alternative is a transfer pricing arrangement.
- ii. **Transfer pricing arrangement:** The partners in each stage agree a transfer price for sale of the gas or LNG into the next stage of the process. Transfer pricing arrangements may lead to conflict, particularly when changing market conditions shift the risk/reward balance between different partners. There is case study of the Malaysia LNG Dua transfer pricing arrangement.
- iii. **Throughput arrangement:** where the upstream partners pay a tolling fee to use the LNG plant and then market the LNG on their own behalf. Although there are no LNG projects currently operating

on this basis, there is case study of Atlantic LNG trains 2 and 3, which will operate with a form of throughput arrangement from 2002.

3. Gas project Feasibility study:

A natural gas project doesn't only depend on technical and engineering skills but it also must depend on the role of the economic, marketing, financial and legal studies and expertise which will lead us to select the best invested project and to utilize our scarce sources. Many factors cannot be translated into dollars. Economic analysis is not and should not be the only criteria in accepting or rejecting a design or investment option. Economics can therefore be defined as 'the study of the allocation of scarce resources'. Economic analysis is therefore undertaken to aid the process of investment decisions. It should provide the decision-makers with the following information:

- i. a view of the future cash flows of a project, both positive in the form of revenue and negative in the form of expenditure and taxation.
- ii. estimates of the profit or loss of a project.
- iii. forecasts of the effect of a project on the overall company position.
- iv. estimates of the risks, both financial, political, commercial and technical, in undertaking the investment.
- v. the relative ranking of a project in comparison with alternative investment options.

To start a feasibility study of natural gas project, we will have to follow the path of these stages:

3.1. feasibility study component:

3.1.1. Technical study:

This stage requires the selection of a limited number of solutions which will be studied in greater detail; these studies can be classified as **technical studies** which work out the technical conditions for carrying out the gas project. (The requirements of raw materials, plant, equipment possible locations and the period required to complete the project, site selection, technology selection, investment & operating cost)

3.1.2. Financial and legal studies (Economic) :

Financial studies which includes analysis of investment & operating costs that involved the cost for each of the solutions considered (cost of equipment manpower, raw materials). Legal, fiscal & financial studies which is a set of assumption particularly about taxation and financial conditions will be established as a basis for calculation.

In general, capital costs include all the expenditures necessary to obtain a working plant. Although they may have different accounting and tax treatments, they include all expenses for engineering, procurement, construction, initial license and taxes, startup and performance testing. These are generally referred to as "**hard costs**". They additionally include those costs for financing fees, environmental permitting, legal costs, interest during construction, contingency, public relations, etc., generally referred to as "**soft costs**".

After having obtained capital costs, "costs of balance" of plant can be estimated by various methods:

1. **construction costs:** these are relatively difficult to estimate accurately. The most reliable information will come from contractors with experience in the type of project being studied and in the geographical region under consideration.
2. **legal, government fees:** many projects require extensive legal work prior to making commitments for equipment procurement and plant construction. This is particularly true for projects that rely on nonrecourse debt financing.

Finally, the feasibility study should determine that all key responsibilities are covered by valid contracts among the project parties and that project risks are appropriately shared.

3.1.3. Market study:

Market study which is a systematic assessment of information on the market and the market environment which analyze the information and provide basis for decision of market nature, define the market situation and its main characteristic, define the interdependencies between competitors and the relation between producers and customers, define the market structure and the characteristic of the corresponding market, determine the possible marketing strategies and determine the marketing tools, Market gap & share, potential local & international markets.

There are two types of market information, namely general market data and specific data for a particular market segment. Most general market data includes data on the following: General economic indicators relating to product demand, such as population level and growth rate, per capita income and consumption, gross domestic product per capita and annual growth rate, income distribution.

Marketing mix clarifies the activates of the 4 policies. It produce much data that may clarify the size of the market and identify companies that have already established a competitive position. These 4 P's are: Product policy, price policy, promotion policy and distribution policy.

i. **Product policy**, feasibility study will have to analyze the present market situation and determine the elements of the product mix and the depth of the product. Natural gas products may differ according to its user (feedstock or fuel) and the process capability which can be limited to produce traditional products or extended to include Natural gas liquefaction (NGL), Liquefied natural gas

(LNG), Compressed natural gas (CNG), Gas to liquid (GTL) and other products beside feedstock to other industries (petrochemicals industries)

ii. **Price policy:** The most relatively significant challenge facing the energy industry is the fluctuating oil and natural gas prices. In order to analyze the complex structure of the natural gas prices in particular, we have to understand one significant concept, namely, the natural gas **pricing chain**, which is closely related to the natural gas supply chain of value and the integrated nature of the natural gas infrastructure. Natural gas prices still linked to oil price or the final products, there is no matured market (spot or future market) which only **started** in 2002 by 5% of its volume.

iii. **Promotion policy:** gas markets still depend on the long term contract and relationship between buyer and seller

iv. **Place:** the gas product concentrated on the place far from the intensive and massive need which affect the cost of transportation of gas products which counted around 20% of the total cost of natural gas products and in some cases need a specially built vessels for lifting LNG products.

A feasibility study, particularly when some or all of the project revenue is not supported by long-term off take contracts, must therefore address three revenues related questions:

1. What volume and pricing level is the market now supporting for your product?
2. How will you differentiate your product from those of competitors?
3. How was the volume and pricing level used in the feasibility study established?

3.2. Select the applicable gas projects.

Decision makers should have to set a comprehensive strategy that achieve different conflicted goals and objectives. The strategy should take into consideration whether to tender all potential areas for explorations or to postponed some of the potential areas for the future. If the tendered areas has a proved reserve, then the decision makers should decide whether to produce to satisfy the domestic need or for exporting and if he decide for a mix, what is the appropriate transmission means, pipeline or LNG ... etc.

3.3. Identify Possible alternatives

Once the decision makers selects the possible project (s), then he has to decide many decisions points regarding the project location and economy, the market access and the market potential, the proven technology, the project timetable, list of vendors, gas supply and purchase agreements, and financial and operation capabilities

3.4. select the appropriate alternatives

Selecting the appropriate alternative can vary from one partner to another. Founder shareholder has to decide the attractiveness of the project from all different opinions in order to attract different partners to the project. If he decides that the project shall be financed as a project finance, then he has to test the project capabilities to generate net cash flow, risk profile, capital structure and its operability as shown in table (2). If he decides to finance the project by recouring the corporate assets (corporate finance) then he has to analyze the corporate financial ratios as shown on table (3). In all cases financial and economic indicators and ratios are not enough to satisfy the stakeholders needs, every partner should perform his due diligence to assure the project financial capabilities versus its risk profile.

3.5. Action plan

Gas projects action plan is not limited to the construction of the project and its time table, but extended to include the loan arrangement, shareholder arrangement, market arrangements and operational arrangements (off take agreements, gas supply agreements)

3.6. Gas projects execution

Gas project execution is not limited to the construction phase but extendable to include the project life time. Gas project is a good example of the learning organization and risk mitigation.

Table (2) shown some of the economic indicators that can be used to evaluate the gas projects:

Method	Net Present Value	Benefit Cost Analysis	Cost Effectiveness Analysis	Portfolio Analysis
What it does	Measures dollar return on projects	Calculates project costs relative to benefits (tangible and intangible) affecting diverse groups	Quantifies tangible and intangible benefits for specific standardized populations	Quantifies aggregate risk relative to expected returns of an entire portfolio of initiatives.
Formula	Present Value of Net Cash Flow – Net Investment	Net Total Benefit/Net Total Cost	Total Cost/Total Output	Return of Investment/Risk of Investment
When to use	When cash flows are private and benefits tangible	When cash flows are social and benefits are both tangible and intangible	When cash flows are private and benefits are both tangible and intangible	When valuating an agency's total risk. Cash flows can be social or private and benefits can be tangible or intangible but must be consistent across the portfolio.
Basic decision rule	For independent projects with NPV greater than \$0, the project should be accepted	If ratio is >1, there is a positive ROI and the project should be accepted. If ratio is <1, there is a negative return	If ratio is >1, there is a positive ROI and the project should be accepted. If ratio is <1, there is a negative return	If ratio is >1, it means there is more return relative to risk and the portfolio is within tolerable risk levels. If the ratio is <1, it means risk is higher relative to return and the portfolio exceeds tolerable risk.
Advantages	Straightforward	Flexible. Allows additional intangible benefits to be included	Useful at analyzing incremental benefits, in terms of achieving specific goals, in relation to marginal costs.	Good for risk-averse decision-makers who may not want to attempt multiple high-stakes, high-risk projects simultaneously.
Disadvantages	Limited to internal capital investments. Does not allow for intangible benefits.	Can be expensive, time-consuming. Challenging to agree on values of intangible costs	Technique not directly related to the outcome; measurement is limited to the cost-effectiveness, not outcomes.	Complex, but could possibly be the most accurate in terms of strategic management.

Table (3): some financial ratios that can be used to evaluate the gas projects:

Ratio	Method of Comparison	Significance
Current	Current Assets, Current Liabilities	Measures short term liquidity, the ability of firm to meet needs for cash as they arise
Quick or Acid Test	Current Assets – Inventory Current Liabilities	Measures short term liquidity more rigorously than the Current Ratio by eliminating inventory (usually the least liquid asset)
Cash Flow Liquidity	Cash + Marketable Securities + Operating Cash Flows Current Liabilities	Measure short term liquidity b considering as cash resources (numerator) cash plus cash equivalents plus cash flow from operating activities
Average Collection Period	<u>Accounts Receivable</u> Net Sales/360	Indicates days required to convert receivables into cash
Accounts Receivable Turnover	Net Sales Accounts Receivable	Indicates how many times receivables are collected during a year on average
Inventory Turnover	Cost of Good Sold Inventories	Measures efficiency of the firm in managing and selling inventory
Fixed Asset Turnover	Net Sales Net Property, Plant and Equipment	Measures efficiency of the firm in managing fixed assets
Total Asset Turnover	Net Sales Total Assets	Measures efficiency of the firm in managing all assets
Debt Ratio	Total Liabilities Total Assets	Shows proportion of all assets that are financed with debt
Long Term Debt to Total Capitalization	Long Term Debt Long Term Debt + Stockholder's Equity	Measures extent to which long term debt is used for permanent financing
Debt To Equity	Total Liabilities Stockholder's Equity	Measures debt relative to equity base
Times Interest Earned	Operating Profit Interest Expense	Measures how many times interest expense is covered by operating earnings
Fixed Charge Coverage	Operating Profit + Lease Payments Interest Expense + Lease Payments	Measures coverage capability more broadly than times interest earned by including lease payments as fixed expenses
Gross Profit Margin	Gross Profit Net Sales	Measures profit generated after consideration of cost of products sold
Operating Profit Margin	Operating Profit Net Sales	Measures profit generated after consideration of operating expenses

Ratio	Method of Comparison	Significance
Net Profit Margin	Net Profit Net Sales	Measures profit generated after consideration of all expenses and revenues
Cash Flow Margin	Cash Flow from: Operating Activities Net Sales	Measures the ability of the firm to generate cash from sales
Return on Investment	Net Earnings Total Assets	Measures overall efficiency of firm in managing assets and generating profits
Cash Return on Assets	Cash Flow from Operating Activities Total Assets	Measures the return on assets on a cash basis
Price to Earnings	Market Price of Common Stock Earnings Per Share	Expresses multiple that the stock market places on firm's earnings
Dividend Yield	Dividends Per Share Market Price of Common Stock	Shows rate earned by shareholders from dividends relative to current price of stock
Dividend Payout	Dividends Per Share Earnings Per Share	Shows percentage of earnings paid to shareholders
Earnings Per Common Share	Net Earnings Average Common Shares Outstanding	Shows return to common stock holder for each share owned
Return on Equity	Net Earnings Stockholder's Equity	Measures rate of return on stockholders (owners) investment

3.7. Sensitivity analysis:

Costs and revenues used as initial values in feasibility studies are unavoidably based in part on inaccurate and incomplete information. It is, moreover, clear that cost and prices change overtime to extents that are not accurately predictable. Projections, although uncertain, must be made.

By its very nature a feasibility study utilizes best estimates of many items. Relatively few of these, however, have a major bearing on conclusions. So a well done sensitivity analysis requires sensitivity to real world relation between factors

Since all of the possible values within the range studied for each variable are not equally likely, various statistical techniques such as Monte-Carlo simulation are being increasingly used.

3.8. Scoring the study

Scoring systems have been applied to numerous business situations including oil exploration, field development and production scenarios. These are inherently based on management 's judgment of the relative importance of a successful outcome for broad categories of requirements such as securing environmental and other permits, completing contractual arrangements for key items, avoiding technological or regulatory obsolesces, etc.

This technique is readily adaptable to helping ascertain whether a feasibility study is successful in the sense that all appropriate factors have been considered, with adequate attention having been devoted to the most important areas.

4. Conclusion:

1. Gas projects feasibility study should be a comprehensive study that integrate upstream, mid stream and down stream impact.
2. Due to the world shift toward gas, expected gas projects world wide shall require an intensive capital requirement.
3. The scarcity of the capital fund shall delay the execution of the less attractive gas projects during the next decades.
4. Gas projects founder shareholder or petroleum sector decision makers has to study carefully the financial incentives provided to the potential gas projects investors, lenders or equity shareholder.
5. Different pricing technique can be utilized to attract upstream supplier such as upstream margin, stable price system linked with oil or the final product.
6. LNG industry adopted three techniques, integrated approach, throughput approach and tolling approach.
7. Gas projects feasibility studies consists of technical study, market study and economics studies.
8. Gas project feasibility study should satisfy the need of all concerned parties (Stakeholders, producers, consumers and host government).
9. Gs project feasibility study should include both the quantitative and qualitative data analysis.
10. Decision makers should evaluate the different techniques to evaluate and select the suitable alternative rather than depending on a single method such as the IRR , NPV or ROI.
11. Feasibility study should be performed based on the open market drivers.

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