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Analytical Study of Natural Gas Pipeline Tariff

Sumeet Gupta
Head, Center for Infrastructure & Project Finance
Arvind Kumar Jain
Head, Department of Marketing & Projects
University of Petroleum & Energy Studies, Dehradun, India

Abstract

Rising crude prices and concerns for climate change have provoked countries into adoption for cleaner and cheaper fuels. The acceptable choice in this regard has been natural gas which has abundant reserves. Gradually, it has become a tradable commodity in the international market, although certain issues still remain related to its tradability. India's consumption for natural gas is rising rapidly in line with the rise for energy consumption in the country fuelled by the booming economy. Over the past decade the volumes have gone up significantly with commencement for NELP gas production, followed by introduction for term LNG and finally with the supplies from RIL's KG D6 gas fields. In a short span for time the gas supply volumes in the country have tripled. Yet the demand for natural gas has been growing and continuing to grow at an unrelenting pace. From the current share for 10% for the energy basket for the country, it is anticipated to grow to about 25% by 2025.

Higher crude oil prices and oil reserves have added to the importance for natural gas as a fuel and feedstock. Natural gas, which is either extracted from the reserves in the country or is imported in the form for LNG and is then re-gasified, needs to be transported to final consumers. India's natural gas pipeline network stretches over 10000 km. A fee is charged by the owner for the pipeline for transmitting gas from the producer to the final customer, which is known as the transportation charge or tariff charge. Transportation charges affect the final price for natural gas. Tariffs are affected by two variables: the methodology used for fixing tariffs and the method used for administering these tariffs. The discounted cash flow and cost for service are the two main methodologies that are used in fixing transmission tariffs. The method for administration for tariffs may be either postal-based or distance-based or zone-based system for fixing tariffs for the customers along the pipeline. Inclusive growth strategies have been mooted by Indian Government to meet the fast paced growth required in developing infrastructure and a framework for development for natural gas as the fuel for choice for the end user. This report attempts to place on record the status for natural gas scenario in India with strategies being/required to be adopted for attaining energy security by 2030. In order for the Indian gas market to reach its potential, there are still many hurdles to be solved on pricing, supply, infrastructure, regulation and policy.

The research can be used to take strategic decisions in relation to investing in a natural gas pipeline with special emphasis on demand estimation and tariff determination. The research (demand and tariff) will be conducted keeping both prioritize (power and fertilizers) and non-prioritize sectors (industries and CGD) in mind.

Introduction

Indian energy (and gas) industry has been built on state-owned companies such as ONGC, OIL and GAIL, but has seen the entrance for some significant private companies in the past few years. Some players are present at many levels for the gas value chain. The conditions for private companies to operate in the Indian market are difficult, due to government interventions on gas prices and allocation, the existence for a dual pricing system and the lack for a transparent, predictable and stable regulatory framework.

India is the world's seventh largest energy producer, accounting for 2.49% for the world's total annual energy production. It is the fifth largest energy consumer, accounting for about 3.45% for total energy consumption in 2004, which has been increasing by an average for 4.8% percent a year since 1990. The share for commercial energy in total primary energy consumption increased from 59.7% in 1980-81 to 79.3% in 2009-10.

India's GDP has grown at more than 8-8.5% during the last few years, and is expected to grow at least at 6.5-7% in the coming few years. The growth has taken place despite the huge deficit in energy infrastructure and infrastructure. Even today, half for the country's population does not have access to electricity or any other form for commercial energy, and still use non-commercial fuels such as firewood, crop residues end during cakes as a primary source for energy for cooking in over two-thirds for households. The future growth for the country would demand a move to large scale commercial energy forms. In particular, natural gas as a clean energy source holds the highest promise for the country.

World's resources for natural gas, although finite, are enormous. Estimates for its size continue to grow as a result for innovations in exploration and extraction techniques. Natural gas resources are widely and plentifully distributed around the globe. It is estimated that a significant amount for natural gas remains to be discovered. Natural gas has emerged as the most preferred fuel due to its inherent environmentally benign nature, greater efficiency and cost effectiveness.

The demand for natural gas has sharply increased in the last two decades at the global level. In India natural gas was first discovered for the west coast in 1970s, and today, it

constitutes 10% for India's total energy consumption. Over the last decade it has gained importance as a source for energy and its share is slated to increase to about 25% for the total energy basket by 2025-2030.

Literature Review

The purpose for this chapter is to study literature for the Natural gas pipeline tariff calculation methodologies for different countries and public private partnership model with an objective to generate inputs for construction for methodology required to determine. Most appropriate tariff determination and recovery methodologies for India considering the nascent stage for gas market development.

Tariff and Contract Price Structure

Economic theory for natural gas pricing implies that each unit for natural gas should be priced according to the incremental demand for supplying the next tranche, meaning that the price should be set to recover the marginal cost per unit for exploration, production, transportation and distribution as depicted below-

Two-part Tariff structure

A two-part tariff structure in pricing for natural gas is *an accepted norm in gas pricing* and has fixed and variable components

1. Fixed component includes depreciation, interest and return on equity and usually do not vary with the volume for supplies and is also referred to as "**Capacity**" or "**Demand**" charge.
2. Variable components fluctuate according to the volumes for gas supply and primarily include the purchase cost for natural gas and are referred to as "**Energy**" or "**Commodity**" charge. In pipeline tariffs, the variable component is generally the compression cost, which varies with the volumes for gas transported.
3. **Some tariffs include a "Minimum Bill" clause,** which provides for a set charge (relevant demand and/ or commodity charge) over a period for time, which serves to limit the under-recovery for capital, or fixed costs.

In lump-sum contractual situations, up-front payment is made to secure dedication for gas supply. Pricing clause permits the buyer to fix the primary component for fuel cost in order to facilitate project financing.

The *fixed unit price* can be with or without periodic review and are most often used with short-term gas contracts. *Variable Price* situation may imply that all or part for the price determined by a formula using quantity data relevant to the circumstances according to the following variables-

- Comparable gas sales in the same or similar market in same time
- Sales for alternative or competing energy sources
- Prices for "system gas" delivered in market
- Seasonally adjusted prices to account for demand
- Average reference prices from other markets
- Incremental or incentive prices for increase in load factor
- Stepped-up price increase over time (e.g., escalation with reference to inflation)
- Indexed prices relating to changes in CPI or annual GNP deflator

Most common pricing formula make reference to the price for alternative energy (gas, fuel oil, LPG being sold in the buyer's market) and employ market "equalizers" such as:

- date when the contract was entered into
- other material circumstances (shortage, surplus)
- load factor
- seasonal conditions
- allocation between demand and commodity components
- "weighting" according to alternative fuel's respective share for market

Very often pricing formula becomes weak due to lack for access to price reference material (Platt's, Reuters, Asia Pacific Petroleum, etc.) leading to disputes over method

for calculation, subjectivity ("uneconomic", "marketable price"), potential regulatory intervention, ineffective negotiation or arbitration procedures.

Quite often, price is arrived based on competitive bidding or as a result for a negotiated settlement. In such situations, principle for "an arm's length transaction" should be applied, which is very important considering that the "Government take" in terms for profit petroleum and royalty may get adversely affected. Some for the recent pricing arrangements in the country have led to allegations for absence for transfer pricing leading to potential loss for revenue to the exchequer due to lower selling price. Reader may like to refer to related material available in the website for MoP&NG - Report for the Gas Valuation Committee (www.petroleum.nic.in). While one may agree that the report does not attempt to define the principles for gas pricing; *yet its recommendations may have far-reaching consequences in terms for a signal to the gas market that the Government, in order to protect its take, may reopen the price clause in situations where the price for natural gas has or could not be determined competitively*. This implies an additional responsibility on both seller and buyer for gas to follow a transparent process in gas pricing. Internationally, vertically integrated entities in the gas value chain have quite often resorted to a non-transparent pricing mechanism resulting in regulatory interventions.

Methodology

Objective

a. To understand the regulations involved in calculating tariff for a natural gas pipeline.

b. To determine the tariff for a natural gas pipeline and estimate the envisaged consumer market for the same.

c. To perform profitability, sensitivity analysis, and analyze the impact for the same on the producer, marketer for the gas and the end consumer.

d. To suggest the most appropriate tariff determination and recovery methodologies for India considering the nascent stage for gas market development.

Research Design: Deterministic and descriptive.

The topic characterizes following things

1. Information needed is defined only loosely.
2. Research process is structured but flexible.
3. Analysis for secondary data is quantitative.

The major part for the research is a deterministic research design. Some portions follow the descriptive design criteria wherein it has been run on the basis for assumption such as total capital expenditure and pipeline length based on inputs. The design and structure for the model is based on the discounted cash flow model and is made according to the respective PNGRB regulations for the determination for natural gas pipeline tariff.

Research Methodology:

The whole framework for collecting the data for carrying this research will be based upon secondary data as well as primary data. The primary data will be collected through expert discussion and industries visit (GAIL, RGTIL, BPCL, and IOCL). The findings will be used for understanding the regulations involved in calculating transportation tariff for a natural gas pipelines. After that a natural gas pipeline is selected for demand estimation, tariff determination and financial appraisal. Depending up on the financial analysis the profitability and sensitive analysis is done, and recommendation is made for the same.

Need for research:

The future demand for natural gas in India will be driven mainly by two factors:

- The need for new sources for energy to fuel economic growth and improve living conditions; and

- The desire to reduce the consumption for coal and liquid fuels and thus the level for pollution.

These drivers are, however, subject to a number for constraints in determining the actual level for gas demand: the price for gas and its competitiveness *vis-à-vis* other fuels and the rate at which the downstream market is developed in both prioritized (fertilizer and power sector) and non-prioritized sectors (Commercial, industrial and city gas distribution). Many uncertainties will affect the future gas demand level, particularly with respect to the cost for supply and India's ability to create an integrated national transportation and distribution network. Competitiveness for natural gas against coal in power generation will also be a key determinant for gas-demand growth. The research will help in understanding the strategic technicalities involved in natural gas business.

Scope:

The research can be used to take strategic decisions in relation to investing in a natural gas pipeline with special emphasis on demand estimation and tariff determination. The research (demand and tariff) will be conducted keeping both prioritize (power and fertilizers) and non-prioritize sectors (industries and CGD) in mind.

Sources for Data:

Secondary data:

a) Research reports on Natural gas pipeline tariff calculation.
b) Performance and strategy reports for Natural gas companies.
c) Articles on tariff determination methodologies for different countries.
d) White papers on natural gas business.
e) Newspaper articles on regulation and amendments on natural gas in India.
f) Online journals.

Assumptions:

Capital cost estimates for the pipeline project system have been provided by technical consultants for BPCL as on 2010. Further escalation and appropriate inflation has been taken into account for overall project development.

Construction period	36 months
Interest rate on loans	10.25%
Debt: Equity ratio	70:30
Moratorium period	2 years for commissioning for project
Project life	25 years
Corporate tax	33.99%
Depreciation method	3.17% p.a. Straight line method
Inflation	2 %
Pipeline Length	1500 Kilometers
Total Capacity`	30 MMSCMD

Design Capacity:

As per the regulations, the capacity for this pipeline is 30 MMSCMD (which is inclusive for 10 MMSCMD for common carrier); however based on prevailing gas demand and gas availability scenario, the design capacity in first phase will be 30 MMSCMD and which will be augmented in second phase from 30 to 48 MMSCMD.

Unaccounted Gas Losses:

A provision for 0.6% for the annual throughput has been assumed towards Unaccounted Gas Losses.

Variable Costs:

Various variable costs incurred due the project have been considered.

Fixed Operating Costs:

Fixed operating expenses like: salaries & wages, Plan & Administrative overheads, insurance, repairs and maintenance are consider as per the standards.

Escalation in operating costs:

The operating costs have been escalated at 2 % per annum during operations period to account for any increase due to inflation and other factors.

Operational life for project:

For the purpose for profitability projection, the operational life for the project has been considered as 25 years from the date for commencement for commercial operations.

Compressor replacement:

A provision for RS 490.84 Crore has been considered on the present cost for compressor for 15 years.

Depreciation Rates:

Depreciation has been considered at 3.17% (including for compressor) and straight line method has been used to compute the depreciation.

Salvage value:

The salvage at the end for 25 years has been assumed. For working capital it has been assumed at 100% and total line pack is added into total salvage value.

Income tax Rates:

Income tax estimation is based on corporate tax for 33.99%

Conversion Factor for transportation tariff

1 MMBtu	251996	kCal
CV	8400	kCal/ SCM
1 MMBtu	28	SCM
1 MMSCMD	35715	MMBtu

Project Finance:

Project Cost:

The financial appraisal for pipeline along with their spur/feeder lines has been carried out along with tariff calculations as per PNGRB tariff regulations guidelines. Details for methodology forllowed for arriving at final entry gate tariff are as per PNGRB guidelines are given below.

1. The tariff has been determined considering a reasonable rate for return on normative level for capital employed plus a normative level for operating expenses in natural gas pipeline.
2. The rate for return on capital employed has been considered as 12% (post-tax) and pre-tax return on capital employed has been computed by grossing up 12% which works out to 18.18%.
3. The total capital employed includes working capital (equal to 30 days for operating costs and 18 days for receivables) which has been considered for calculating tariff.
4. Level zed tariff has been calculated for Main Trunk Line and Spur Lines up to 50 Kames range for Main Line (put together) and thus corresponding capital

cost, operating cost, receivables and working capital have been considered together for arriving at the Level zed tariff.

5. The capacity utilization has been assumed as 60%,70%,80%,90%,100% in 1^{st},2^{nd},3^{rd},4^{th} & % 5^{th} year for operations and thereafter respectively.
6. The economic life for the project has been considered as 25 years for operations in case for first phase.
7. The Level zed tariff has been arrived based on the 'Discounted cash Flow(DCF) methodology' equating the inflows from the projected revenue earnings out for natural gas pipeline tariff with the outflows for the capital and operating expenditures over the economic life for the project by discounting these flows at the project's reasonable rate for return(viz.18.18% pre-tax).
8. Capital employed includes Cape for pipelines besides Margin Money for working capital, Line Pack and interest during construction (IDC).

The major factor/assumption considered in the Financial Appraisal is as follows:

Debt: Equity	70:30
Long Term Debt Interest Rate	10.25%
Moratorium	1 year
Term for loan including moratorium	10 years
Income Tax Rate	33.99%
Volume Build Up **1^{st} year** **2^{nd} year** **3^{rd} year** **4^{th} year** **5^{th} year**	 60% 70% 80% 90% 100%
Project life	25 years
Unaccounted Gas	0.60% for throughput
Project IRR (Post-Tax) on capital employed as per PNGRB guidelines	12%

Total Revenues

Revenue details for the trunk line and other spur line has been arrived on the demand estimated and PNGRB guidelines for capacity utilization, following table gives year wise revenues till year 10 for trunk line and spur lines which are above 50 km in length.

			Year	1	2	3	4	5	6	7	8	9	10
Opening Block of Assets				7187	6829	6471	6113	5755	5397	5039	4681	4323	3965
Depreciation				358	358	358	358	358	358	358	358	358	358
Closing Block of Assets				6829	6471	6113	5755	5397	5039	4681	4323	3965	3607
Opex				144	158	174	191	210	231	254	279	307	338
Volumes													
Capacity Utilization				60%	70%	80%	90%	100%	100%	100%	100%	100%	100%
Throughput		MMSCMpa		8498.7	9915.15	11331.6	12748.05	14164.5	14164.5	14164.5	14164.5	14164.5	14164.5
Tariff		Rs./ MMSCM		1.07	1.09	1.11	1.13	1.15	1.17	1.19	1.21	1.23	1.25
Revenue		Rs. Crore		907	1081	1258	1441	1629	1657	1686	1714	1742	1771
Opex		"		144	158	174	191	210	231	254	279	307	338
PBDT		"		763	923	1084	1250	1419	1426	1432	1435	1435	1433
Depreciation		"		358	358	358	358	358	358	358	358	358	358
PBT		"		405	565	726	892	1061	1068	1074	1077	1077	1075
Tax		"	33%	134	186	240	294	350	352	354	355	355	355
PAT				271	379	486	598	711	716	720	722	722	720

Revenue Sheet

The revenues for the project life are based on the estimated tariff/MMBTU. Following table indicates revenue details for the project till year 10.

Capital Expenditure

The capital expenditure for the project is computed based on the cost estimates for various parameters such as land, No objection certificate, pipeline cost including laying, SCADA system, compressor cost and other expense during the economic life for the project. Capital expenditure also includes project management cost, owner's management expenses and contingency cost. The pipeline length is assumed to be 1500 km trunk pipe line for 48 inch diameter. The various assumptions are shown in table for capital expenditure is:

Cost for Compressor:

Total cost for the compressor is assumed as Rs 500 Crores which includes compressor cost, compressor cooler, scrubber, fuel gas conditioning skid, compressor valves & accessories, compressor piping, fitting and equipment, electrical & instrumental items, utility items, compressor station construction cost.

Natural Gas Pipeline				
	DESCRIPTION			**Rs. Crore**
1	Land			20
2	ROU/ NOC			50
3	Pipe cost including laying			5250
3	SCADA & APPS SYSTEM			20
5	Compressors			500
6	Others			100
	Sub-Total			**5940**
	PROJECT MGMT. EXPENSES INCL. PMC		4%	238
	OWNER'S MGMT.EXPENSES		2%	119
	CONTIGENCY		15%	891
	TOTAL			**7187**

Cost Sheet

Operating Expenditure:

Operating cost required for the operation and maintenance for the project for the proposed Pipeline Project over its economic life is computed by assuming 2% for the total capital expenditure and following table provides costs for various functional heads in phased manner.

			Year	1	2	3	4	5	6	7	8	9	10
Opening Block of Assets				7187	6829	6471	6113	5755	5397	5039	4681	4323	3965
Depreciation				358	358	358	358	358	358	358	358	358	358
Closing Block of Assets				6829	6471	6113	5755	5397	5039	4681	4323	3965	3607
Opex				144	158	174	191	210	231	254	279	307	338
Volumes													
Capacity Utilization				60%	70%	80%	90%	100%	100%	100%	100%	100%	100%
Throughput		MMSCMpa		8498.7	9915.15	11331.6	12748.05	14164.5	14164.5	14164.5	14164.5	14164.5	14164.5
Tariff		Rs./ MMSCM		1.07	1.09	1.11	1.13	1.15	1.17	1.19	1.21	1.23	1.25
Revenue		Rs. Crore		907	1081	1258	1441	1629	1657	1686	1714	1742	1771
Opex		"		144	158	174	191	210	231	254	279	307	338
PBDT		"		763	923	1084	1250	1419	1426	1432	1435	1435	1433
Depreciation		"		358	358	358	358	358	358	358	358	358	358
PBT		"		405	565	726	892	1061	1068	1074	1077	1077	1075
Tax		"	33%	134	186	240	294	350	352	354	355	355	355
PAT				271	379	486	598	711	716	720	722	722	720

Open Sheet

Methodology for Tariff Calculation:

The natural gas pipeline tariff shall be determined by considering a reasonable rate for return on normative level for capital employed plus a normative level for operating expenses in the natural gas pipeline

1. The unit rate for natural gas pipeline tariff to be charged for a period shall be the calculated based on the Discounted Cash Flow ”DCF” methodology considering the reasonable rate for return as specified in the regulation to be considered as projects internal rate for return.
2. The rate for return on capital employed shall be the rate for return on capital employed equal to percentage post-tax. The rate for return on capital employed once applied to a natural gas pipeline project shall remain fixed for the entire economic life for the project.
3. The total capital employed shall be equal to the grossed fixed assets in the project less accumulated depreciation plus normative working capital (equal to thirty days for operating cost excluding depreciation and eighteen days for natural gas pipeline receivables).
4. The volumes for natural gas to be considered as divisor in the determination for unit natural gas pipeline tariff over the economic life for the project shall be computed on a normative basis as indicated below.
5. The divisor for each for the first five years for operation for the natural gas pipeline shall be arrived by multiplying the applicable percentage utilization for the year, as per the basis indicated below, with the sum for the capacity requirement for the entity and the firmed up contracted capacity with other entities as specified under the PNGRB Regulations 2008.

Year for Natural Gas Pipeline Utilization	Percentage Utilization
First	60%
Second	70%
Third	80%
Fourth	90%
Fifth	100%

- The divisor for the sixth and the subsequent years for operations for the natural gas pipeline are equal to one hundred percent for the sum for the capacity requirement for the entity or the actual volume for the natural gas transported on common carriers.

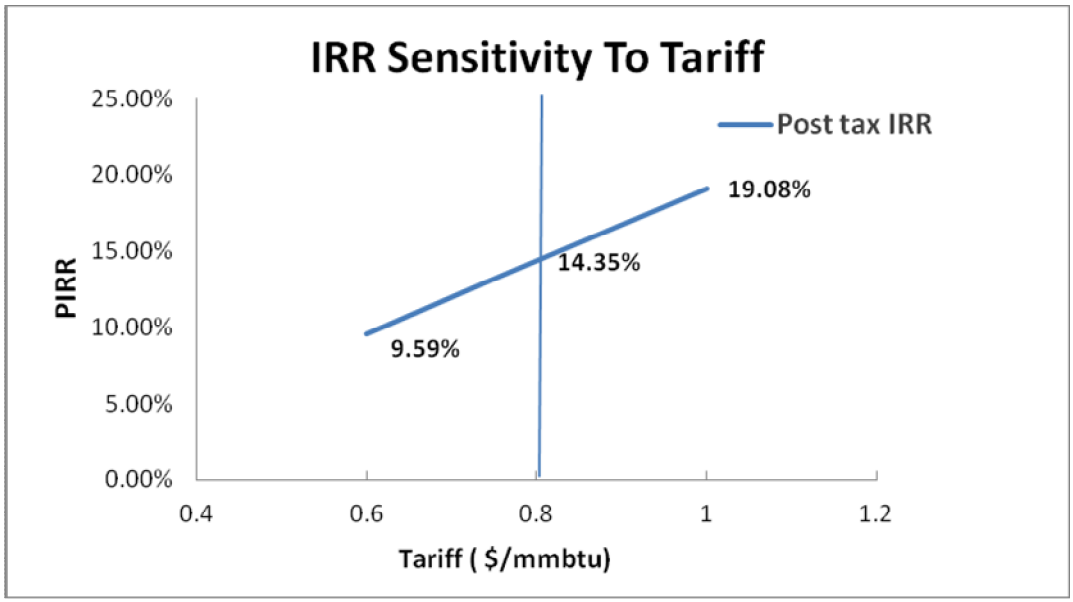
Data Interpretation and Analysis

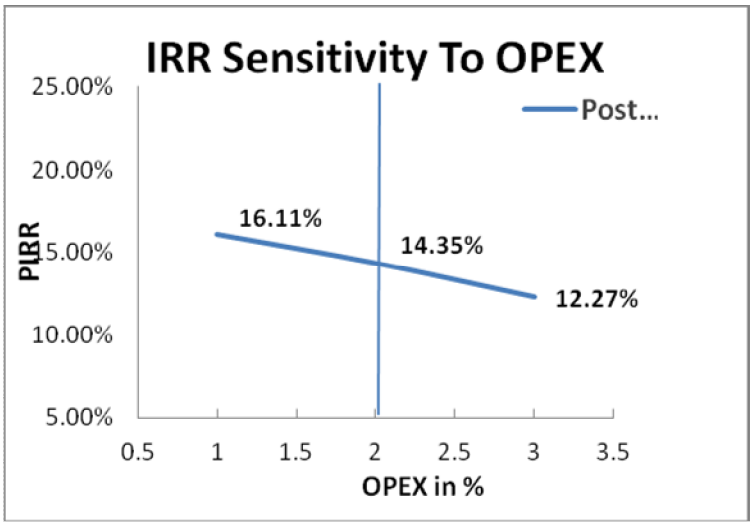
Sensitivity Analysis

A sensitivity analysis has been carried out to ascertain the effect for the following scenarios on the major financial parameters for the Main line / Trunk Line. Following Table provides the analysis for parameter like Project IRR post tax changes with the change in tariff.

Tariff	Post tax IRR
0.6	9.59%
0.8	14.35%
1	19.08%

Here for the base case tariff is taken as 0.8 $/MMBtu for which the post tax IRR is 14.35% as we changes the tariff from 0.8 $/ MMBtu to 0.6 $/ MMBtu the post tax IRR changes to 9.59%, similarly when tariff changes to 1$/MMBtu the post tax IRR changes to 19.08%.





Opex	Post tax IRR
1	16.11%
2	14.35%
3	12.27%

Here for the base case operating capital expenditure is taken as 2% for the capital expenditure for which the post tax IRR is 14.35% as we changes the operating capital expenditure from 2% to 1% for the capital expenditure the post tax IRR changes to 16.11%, similarly when operating capital expenditure changes to 3 % the post tax IRR changes to 12.27 %. The graph showing the changes in PIRR value.

Conclusion

The tariff design methodologies for natural gas pipelines usually depend upon the industrial sector, ownership, access condition and forms for regulation prevailing in the particular country. The tariff setting mechanism is governed by three main concerns i.e. passing for economic surplus, attracting private investment, introducing efficiencies in transportation. The level for competition and regulatory intervention to an extent affect the tariff design policies. The primary goal for any tariff design methodology is cost reflective cost recovery simplicity promoting efficient use for system completion and flexibility. Pipelines are natural monopolies especially distribution networks due to high non gas costs and hence call for some kind for rate for return on tariff regulation for efficient use for system and disallowing monopoly rent to the service provider. Tariff design principle are normally based on the relative importance for the cost factors which in turn are affected by numerous factors like distance from supply source to delivery point, the type for regulation and cost allocation, the load profile for the end user and the degree for gas to gas completion.

Tariff structures for utilities in North America, UK and Europe provide thoughtful insights into tariff setting for evolving market subject to the development stage for the gas industry, consumer profile and government controls.

Recommendations

1. Tariff design for any utility should depend on the maturity for the existing market and the objective for the price regulation.
2. Tariff design must address the concerns for
   a) Promoting efficiency in transportation.
   b) Create incentives for transmission and distribution
   c) Safeguard the interest for the consumer
3. Tariff regulation can acts as surrogate for the market where market cannot adequate discipline forces especially for India where gas market is still evolving and opening up completion would mean duplication for assets and utilized capacities.
4. Cost for service methodology though fair in sense that the revenue recovered is closed to its accounting cost however fail to achieve technical allocate and dynamic efficiency by not reflecting the marginal costs incurred. Hence it should do away with and replaced with an incentive based regulation.
5. Straight fixed variable rate for pricing should be adopted since it allows the pipelines to recover their cost for service but does not allow recovering. Hence it does not allow a pass through for the cost and promotes operational efficiency

Rate for return earned by the pipeline must not only based on the capital structure for the investment but also take a realistic view for financial and business risk associated with it .i.e. it must be based on CAPM.

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