FUNDAMENTALS IN LNG

Tom Quine

Northstar Industries, Inc.
126 Merrimack Street
Methuen, MA 01844

The following discusses the historical use and future opportunities relating to natural gas, LNG and geological gas storage. New opportunities are presented by the non-linear 23.5 tcf/y US gas use and declining production. This fact has created a significant need for LNG imports and LNG distributed assets in the US. In addition it has created a need for market based and production based geological storage with services ranging from firm contracts, wheeling and hub based park and loan.

Background

The natural gas industry began in mid 19th century in the US with technology related to low BTU coal gas production for city lighting and eventually industrial coal gas use. Gradually an infrastructure was developed from the Gulf States to deliver natural gas throughout the US as high BTU natural gas transmission and distribution. The long haul transmission capacity charges led to the development of propane peak shaving, LNG peak shaving and geological gas storage in the 60's and 70's. These were rate-based initiatives, which reduced rates but gave little motivation for investors. With deregulation these fundamentals have forever changed as witnessed by the desire for entry by the majors, developers and financial institutions and by decline in opportunities in the power sector.

By all accounts, the U.S. natural gas production is declining while gas use is increasing steadily on an annual basis to the current non-linear 23 trillion cubic feet (tcf) per year. The resulting $6 MMBTU commodity price is accompanied by opportunities for solutions. Although a certain amount of demand destruction is expected because of the high price, the supply shortfall could increase to 5 tcf per year within the next decade if 2% of growth per year in gas use continues.

New domestic supplies and increased imports of stranded reserves have been targeted as part of a "long-term solution" for base load supply in the U.S. Imported LNG has also received a great deal of attention with expansion of existing import terminals and siting of new energy resources along the coasts. There is a general recognition for the requirement of production based geological gas storage as well as market based gas storage where geology permits.

LNG plays a vital role in natural gas supply in the U.S. There are four existing import terminals in the continental U.S. and one export terminal in Alaska with many new import projects on the horizon. In addition, there are more than a hundred distributed LNG facilities that provide high deliverability natural gas to meet peak demand.

Some of these are described as satellite facilities that store and receive LNG via overland trucking and vaporize the product on demand. The balance of the plants have the ability to liquefy natural gas from a pipeline supply and store the product on site for future use. The focus of LNG use has been on the import terminals with little understanding for the historic use of the hundred other existing plants operating in the midstream and downstream market.

The problem of U.S. gas supply can only be understood in the context of the non-linear load factor of gas usage, which creates a peak demand that far exceeds the average daily usage. The other significant fact is that the pipeline capacity charges can add $1-2 per MMBTU per day of availability and in many cases the capacity is not even available for growth in send-out with the existing pipeline infrastructure. This puts the value of 100 MMscfd of capacity at $36-72 million per year in these regions. The economic case for LNG peak capacity is easy to make when the demand or capacity charge for natural gas exceed $.50 per MMBTU per day and the load factor for the customer is less than 50%.

These facts and their implications are not clearly understood by many policy makers and industry experts in the U.S. Simply adding import capacity at the extremities of the gas market, or developing new domestic supplies, will not solve the gas supply problem. The gas transportation infrastructure with its capacity demand charges and inadequate delivery capability will need to undergo significant reinforcement of the infrastructure and installation of marine import capacity and the accompanying business case for these upgrades are a long-term problem with a long-term solution.

The installation of distribute LNG assets represents a near-term solution for the capacity and commodity relief in the regions that need it the most: midstream and downstream regions of the gas market where load factors are less than 50%. The business cases for these fast track solutions are compelling and easy to understand when explained clearly in a historical and forward looking context.

Historical Use of Natural Gas, LNG

In order to understand the opportunity for natural gas supply assets in the US a good understanding of the usage pattern today is a requirement. Below is a natural gas summary for the US for 2004 in approximate numbers.

US Gas supply Summary 2004

Annual Use: 23 tcf/year
Current Domestic Production Trend: 20 tcf/y and declining
LNG imports and trend: 600 bcf/year and climbing
Canadian Imports and trend: 3 tcf/y and declining
Geological Gas Storage: 3.5 tcf
Number of Storage Facilities: 400
LNG Storage: 100 BCF
Number of LNG Plants: 96

The natural gas usage pattern on an annual basis must be understood to properly prescribe solutions to the supply and capacity problems. Although the U.S. uses 23 tcf per year, the daily peak load of gas is not 23 tcf/365 days. That being the case, the daily peak use would only equal 60 billion cubic feet per day (bcfd). The daily peak use of natural gas is approximately 100 bcfd thus exacerbating the supply problem. Annual load duration curves are a tool utilized by gas supply planners for providing a linear regression analysis of 365 days (x axis) and daily send-out (y axis). If this curve represented the annual use of gas in the U.S. then the peak daily use in the attached summary presentation would be approximately 100 bcfd and the area under the curve would be equal to 23 tcf per year. The summer base load is 40 bcfd.

The 96 distributed land based LNG assets in the U.S. have been sited to provide peak capacity relief as a means of avoiding pipeline capacity charges and system pressure relief during peak send-out periods. The four marine terminals have been sited to increase baseload imports on a commodity basis. The one export terminal is located in Alaska providing approximately 150 bcf/year to Japan.

LNG currently represents 2.5% of the 23 tcf per year supply portfolio but represents a crucial part of peak day supply.

The non-linear nature of gas usage in the U.S. presents an excellent opportunity for distributed supplies of LNG to provide capacity and commodity relief in a regional basis. Solutions to date have focused on increasing imports at marine terminals with little regard for distributing this commodity and with lack of impact on capacity constraints in midstream and downstream markets. Obstacles in growth of LNG in the U.S. historically have been due to a rate-based view of the market with little regard to simply purchasing new pipeline supply. The lack of LNG infrastructure, public awareness, project finance, and technical expertise are also obstacles to the increased use of LNG in the U.S.

Economics

Base Load Such, as Stranded Gas Asset is a fuel-to-fuel comparison:

LNG Fuel Cost$1.50 - $7.00 / MMBTU At Source
$0.50 - $1.50 / MMBTU: Trucking or Liquefaction
Sub Total = $2.00 - $8.50 / MMBTU Delivered

Total Cost per MMBTU Must Include Facility Carrying Cost As Follows:

Annual Carrying Cost per MMBTU = (Annual Mortgage + O&M + Overheads)

Annual LNG Use

As an example a $10 MM stranded gas liquefaction storage and trucking project produces 5 BCF / year and the gas is purchased for $2 per MMBTU. If the annual mortgage, O&M and trucking cost is $5MM then this will add $1 per MMBTU to the $2 dollar gas which is very competitive.

Peak Shaving is typically justified by avoided peak capacity

Annual Carrying cost of Peaking Plant = Annual Mortgage + O&M + Overheads

This annual cost must then be compared to the peak capacity.

As an example a 2 BCF, 200 MMCFD peaking plant costing $80 MM can avoid peak daily charges. At $1 MSCFD/day this service is worth $72 MM per year. If the annual mortgage and operating costs of this facility is $15 MM then this compares quite favorably with the $72 MM capacity cost.

Gas Storage Economics:

The economics of these services are much more complex than the scope of this letter. These services today can be for base firm contracts, and market based services, which can yield $1-$2 per year for each bcf of storage.

This means that a $200 MM, 20-bcf storage fields can typically generate $20-$40 MM per year of revenues.

Relative Costs of Storage Facilities:

20,000 MMBTU LNG Satellite: $8 MM ($400 per MMBTU)
2 BCF LNG Facility with Liquefaction: $80 MM ($40 per MMBTU)

27 BCF Depleted Reservoir Storage: $180 MM ($8 per MMBTU)
24 BCF Salt Cavern Storage: $240 MM ($10 per MMBTU)

Conclusions

New midstream and downstream LNG and geological storage assets provide a near-term solution for assisting in the capacity and commodity constraints facing many regions in the U.S. This solution will be valuable whether the shortfall in supply is filled at the extremities with the new LNG imports and/or increased domestic production. Both cases allow for added system capabilities with distributed storage solutions.

The use of LNG is expected to increase from 200 bcf per year to 2.3 tcf per year in the next decade. This cannot occur by simply increasing imports at the marine terminal. This increase will require many more local and regional LNG assets along with geological storage where available in order to position LNG for avoided demand and pipeline upgrades.

This solution requires education, concise regulation, available technology, market development, and asset development. The increased use of LNG can provide distributed solutions on a small local basis and on a larger regional basis as a hub for expansion.

Peak shaving economics are driven by avoided capacity charges largely independent of the commodity cost of the feedstock LNG. At $.5 per MMBTU of capacity charges, LNG provides an attractive alternative to firm pipeline capacity for low load factor customers.

For high load factor, base load customers the analysis focuses on a fuel-to-fuel comparison, which must consider the carrying costs of the new asset along with the base cost of the imported feedstock. The high price of natural gas today makes imported LNG pricing very attractive.

The energy needs of the U.S. are diverse and growing and the use of LNG as a distributed supply and commodity enhancement presents a fast track, short-term solution during critical peak periods when these prices and availability of supply are most severe. Distributed storage and send out satellite systems with liquefaction, storage, send out, and trucking can enhance the existing infrastructure and supply the 1000% growth needed in LNG facilities in order to support the growth in our economy.