

## High-strength Steel Pipeline Economics

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### ABSTRACT

The recent development of X120 (Grade 825) high-strength steel linepipe enables gas producers to realize significant savings in the total cost of long-distance gas transmission pipelines, lowering the cost of supplying gas to market. These savings can be achieved from cost reductions in multiple areas, including material, construction, compression and integrated project operations. This paper describes methods of achieving these savings and presents examples of pipeline project scenarios where application of X120 linepipe in higher-pressure, smaller-diameter pipelines results in total project cost savings of 5% to 15%.

### INTRODUCTION

Transportation cost has long been a key factor in the commercialization of remote gas resources. In the early 1990s, ExxonMobil began research on a project to reduce the cost of gas transmission pipelines through the use of linepipe manufactured from lower-cost, higher-strength steel. The concept was that additional commercialization opportunities would become economic by fully capturing the benefits of high-pressure transmission for large volumes of gas. The resulting impact of having this capability would be to expand the economic reach of gas pipelines, thus enabling transportation from remote resources to market centers.

The evaluation of how to most economically transport gas from remote sources of supply is a critical consideration in today's social and economic environment. With the demand for gas growing rapidly, gas supply scenarios requiring long-distance gas transportation systems are being considered. Gas transportation methods—including liquefied natural gas (LNG), compressed natural gas (CNG) and new materials for pipeline transmission—are being evaluated to determine what can be done to drive down the cost and position the technology as the future preferred alternative. The higher-strength steel described in this paper provides an opportunity to not only reduce pipeline transportation costs, but in many cases may enable development of remote resources currently not commercial using existing technology.

Realizing these benefits presented many challenges. Among the challenges ExxonMobil recognized when the project started was the need to make a stronger steel that:

- cost less than existing linepipe steel on a cost-per-unit strength basis,
- provided a step change in strength above conventional steels,
- had adequate fracture toughness at operating temperatures, and
- was easily weldable.

The high-strength steel development work at ExxonMobil, in conjunction with Nippon Steel Corporation and Sumitomo Metal

Industries, has resulted in steel pipe with a nominal yield strength of 120 ksi (825 MPa) and the potential to reduce the total project cost of long-distance pipelines on the order of 5% to 15%.

As expected, direct replacement of lower-strength linepipe with thinner-wall, high-strength steel pipe reduces steel tonnage and results in linepipe cost savings. However, the full economic and technical benefits of high-strength steel are only realized when the pipeline operating pressure is increased. High-strength steel makes it economic to transport equivalent volumes of gas through smaller-diameter lines at high pressure. The ability to design higher-pressure, smaller-diameter pipelines with moderate wall thickness retains the material cost advantage of high-strength steel while providing opportunities to reduce construction and compression costs, thus providing the lowest cost in delivering gas to market. Use of high-strength steel at higher pressures also offers the potential to reduce the cost of gas development projects by allowing additional optimization of process facilities based on the capabilities of the pipeline system.

This paper describes the various categories of cost savings possible through application of high-strength linepipe, and gives examples of screening cost-savings analyses for the application of high-strength steel in 3 pipeline project scenarios.

### HIGH-STRENGTH STEEL APPLICATION LOWERS COST

To fully capture the economic benefits of applying high-strength linepipe in long-distance gas transmission projects, all aspects of the project need to be evaluated. Benefits from application of X120 can be derived in each of these 4 areas:

1. Reduced material cost
2. Lower construction cost
3. Reduced compression cost
4. Integrated project savings.

#### Reduced Material Cost

With direct replacement of lower-strength steel with high-strength steel, pipe wall thickness is reduced, resulting in fewer tonnes of steel required and lower overall pipe cost. Material-replacement cost savings alone can reduce the total cost of a long-distance pipeline project. The example below illustrates a total project cost savings of 4% due to reduced material costs.

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