

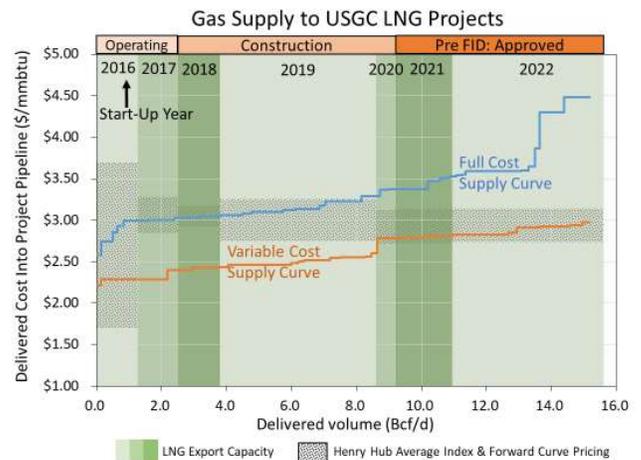
## North American LNG Export Project Gas Supply Competition Study: U.S. & Canadian Northeast vs. U.S. Gulf Coast Markets

The North American gas market has undergone a fundamental realignment with the US shifting from an import dependent consumer to an export and supply driven market resulting from hydraulic fracturing of shales, which has unlocked a combined 4,000 Tcf of natural gas in North America. This unprecedented growth in production from shales has resulted in the U.S. market for LNG transforming from a net importer to a net exporter, and the U.S. pipeline gas market reducing import volumes by 1/3 of their recent peak value. These developments have left America's LNG import infrastructure nearly idle, and spurred extensive investment in pipeline infrastructure to meet the dual requirements of rapidly growing production and emerging export driven demand.

North American natural gas markets have transitioned from a net import-reliant market to a balanced market, characterized by short-term (mainly seasonal) interregional constraints, and now to a market which currently exhibits demand constraints throughout available domestic markets. Low-cost gas from Marcellus, Utica and other gas production centers has driven down the reference index of North American gas prices (Henry Hub or HH), and displaced imported gas from several of its historical markets. An increasing oversupply of natural gas in the North American marketplace has given rise to a burgeoning pipeline and LNG export market concentrated along the U.S. Gulf Coast (USGC). Existing interstate pipeline infrastructure is challenged by both rapid production growth in developing production regions and a growing USGC export market.

Despite the abundance of pipeline infrastructure in North America, in its existing configuration it is ill-suited to serve the requirements of rapidly expanding shale production and USGC LNG export demand. Due to the location of major shale production regions, substantial pipeline infrastructure re-development has taken place and is still required to gather produced volumes and transport this production to emerging LNG export demand markets. A legacy pipeline system designed to transport volumes from the USGC to demand centers in the Northeastern U.S. has been reversed and modified to meet the dual needs of serving traditional markets in the Northeast and LNG export markets on the USGC (Chart). Nearly 51.6 million tonnes per annum (Mtpa) of additional LNG

export capacity is currently approved by the Federal Energy Regulatory Commission (FERC) but not currently under construction. In 2016 0.5 Bcf/d of pipeline export capacity was added to the existing 7.7 Bcf/d in Texas to deliver fuel for power projects in Mexico. Another 3.1 Bcf/d will be completed by the end of 2017 and 2.7 Bcf/d is in the FERC application process or announced. Substantial pipeline infrastructure investment will be required to meet the combined requirements of this second wave of proposed LNG export projects and pipeline exports to Mexico. Given that the capacity to reverse flow on existing interstate pipeline systems is reaching its limit to serve LNG and pipeline export projects either operating or under construction, incremental capacity will arguably have a significantly higher cost (Chart).



The Marcellus and Utica shales have consistently demonstrated the greatest potential production capacity and have become the dominant production region in the U.S., accounting for 27% of total U.S. production in 2016.<sup>1</sup> Production from the Marcellus and Utica has for several years greatly exceeded the local and regional demand, forcing producers to seek markets outside of the region, including long-haul transport the USGC. With the lower cost pipeline expansions and reversals exhausted, the USGC export projects will have to balance higher transportation costs from Marcellus/Utica with lower transportation costs from geographically advantaged basins with historically higher production costs. Regardless of the choice, natural gas costs for LNG projects that have yet to secure their supply could be as much as \$1.35/mmbu above projects that have secured firm transport capacity(Chart).

<sup>1</sup> United States Energy Information Administration Natural Gas Data: U.S. Dry Natural Gas Production