

The Shale Crescent USA Region

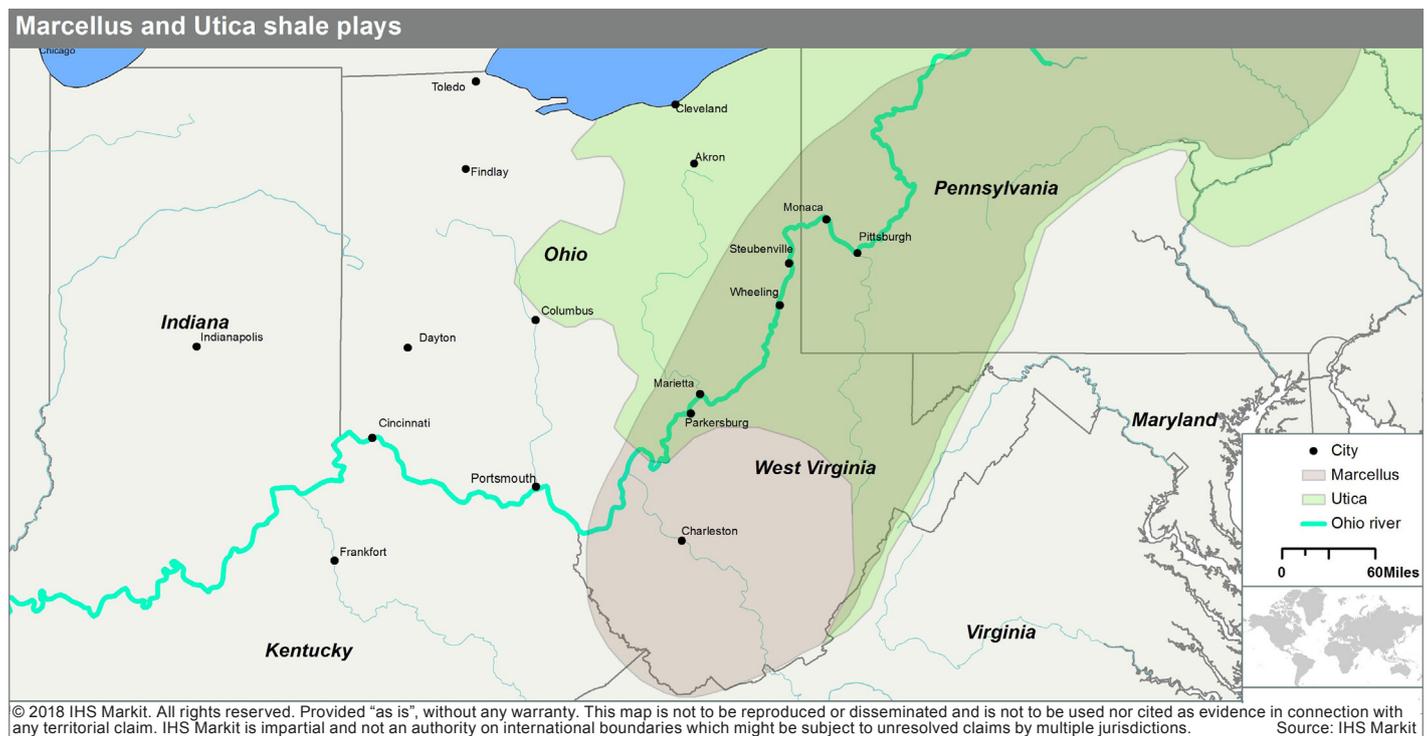
An emerging energy cluster

March 2018—Final

Introduction

The Marcellus and Utica shale plays are some of the largest natural gas resources in the world and underlay the Shale Crescent USA region of Ohio, Pennsylvania, and West Virginia. **IHS Markit forecasts that this region will supply 37% of the nation's natural gas production by 2040.** Furthermore, the United States is the number one producer of natural gas in the world. The natural gas produced in the Marcellus and Utica shales is rich in natural gas liquids (NGL), including ethane. IHS Markit forecasts NGL production from these two plays will increase from 0.53 million barrels per day in 2017 to 1.37 million barrels per day in 2040, an increase of over 150%. Previous studies estimated the region has sufficient ethane feedstock to support up to five world class ethane cracker plants, including the Shell Chemicals plant under construction in Monaca, Pennsylvania. The resource base in the Shale Crescent USA region is attracting energy-intensive industries. **This IHS Markit report examines the economic benefits and risks of significant investments in the region and compares them with competing opportunities in other US and global regions.**

Benefits, Risks, and Estimated Project Cash Flows: Ethylene Project Located in the Shale Crescent USA versus the US Gulf Coast is an independent report by IHS Markit commissioned by Shale Crescent USA to evaluate and compare the financial returns



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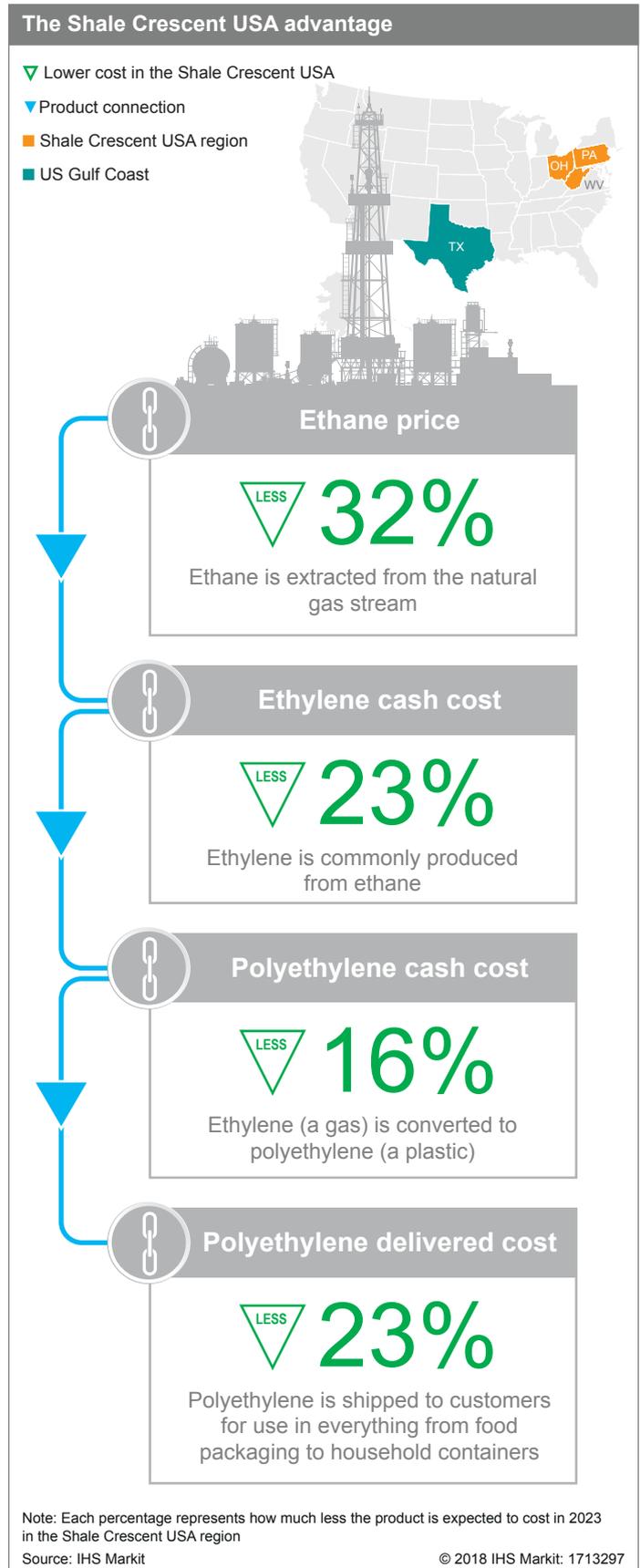
and risks of a major petrochemical and plastics investment in the region with an identical investment in the US Gulf Coast. The US Gulf Coast currently leads the world in petrochemical manufacturing expansion. The questions addressed by this study are:

- Would a nearly \$3-billion investment in an ethylene/polyethylene plant in the Shale Crescent USA earn higher or lower returns than a comparable investment in the US Gulf Coast over a 20-year timeframe?
- Given the uncertainty in future energy and feedstock price levels, how will financial returns change under low- and high-ethane price environments?
- How will other risk factors affect financial returns, such as differences in capital costs, operating rates, proximity to customers, and access to international markets?

The analysis conducted by IHS Markit highlights the economic opportunities for the Shale Crescent USA region based on predicted volumes and prices of natural gas and NGL production in the Marcellus and Utica shale plays, the estimated capital and operating costs to convert ethane (the primary raw material) into its derivative products (ethylene and then polyethylene), and the cost to distribute polyethylene to a mix of domestic and international customers.

Findings

The findings conclude there will be a significant financial advantage for an ethylene/polyethylene investment in the Shale Crescent USA region compared to a similar investment on the US Gulf Coast. An ethylene project in the **Shale Crescent USA has a comparative advantage because of its access to ample supplies of locally produced low-cost ethane**, which leads to a very competitive manufacturing cost of ethylene and subsequently polyethylene. This advantage is augmented because the **Shale Crescent USA region is in close proximity to over two-thirds of US polyethylene consumption**. The financial advantages occur even when the higher capital cost for a Shale Crescent USA ethylene project and the less-well-developed natural gas and NGL pipeline and storage infrastructure are considered. Petrochemical investment will stimulate further economic development in energy and transportation infrastructure and job creation across the region. The study highlights the major benefits, risks, and cash flows.



Financial summary and risk assessment of key variables

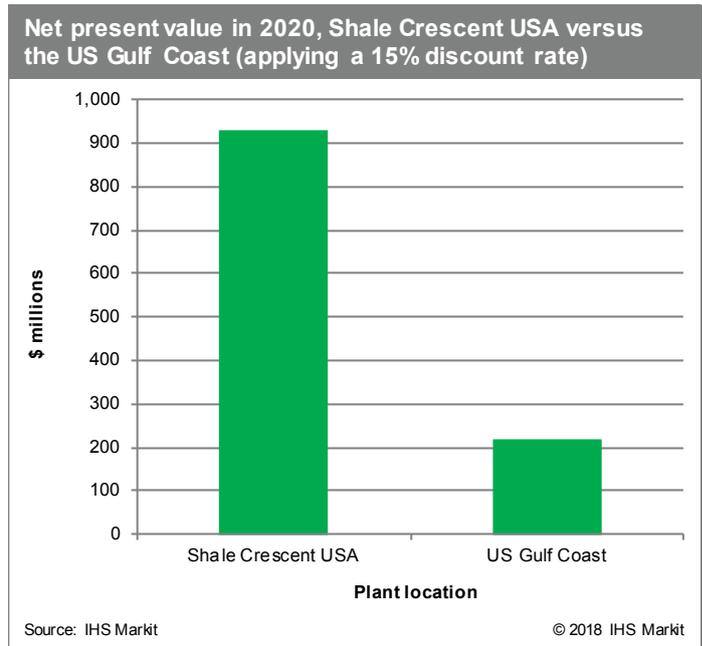
Under the assumptions in our base case and using a 15% pre-tax discount rate, **the IHS Markit analysis predicts that an ethylene project in the Shale Crescent USA region will produce a net present value (NPV in 2020) on EBITDA of \$930 million over the life of the project, compared to a NPV of \$217 million for a similar project on the US Gulf Coast.**¹ This represents an NPV cash flow advantage of \$713 million for an investment in the Shale Crescent USA project versus a project on the US Gulf Coast. The NPV cash flow is over four times higher in the Shale Crescent USA project than in the US Gulf Coast project. **Without considering the time value of money, the pre-tax cash flow of the Shale Crescent USA project from 2020 to 2040 amounts to \$11.5 billion, compared to \$7.9 billion for a similar Gulf Coast project, a pre-tax cash flow advantage of \$3.6 billion.**

IHS Markit conducted a “stress test” to determine the ability of each project to deal with higher-than-expected capital costs and lower-than-expected plant operating rates. Using a 15% pre-tax discount rate, the Shale Crescent USA project produced negative NPV returns in only 1% of the 10,000 simulations, and the Gulf Coast project produced negative NPV returns in 38% of the simulations. A negative NPV indicates that a simulation delivered less than a 15% rate of return.

The bottom line

The expected financial returns for a Shale Crescent USA project compared with a Gulf Coast project are higher under all analyzed price scenarios, and these results are robust when considering a range of capital cost, operating rate conditions, and domestic/international sales scenarios.

The comparative financial advantage for a Shale Crescent project would be further enhanced if more-than-anticipated transportation facilities, natural gas and NGL storage, and pipeline infrastructure development occurs in the region.



¹ EBITDA is defined as earnings before interest, taxes, depreciation, and amortization.

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