Don Bari, vice president, technology and analytics group, IHS Chemical, provides the following updated analysis on the commercial viability and economics of a new petrochemical process for the direct conversion of methane to ethylene production using the Siluria Technologies’ process, which is now being leveraged at the company’s demonstration plant in La Porte, Texas.

Start-up of Siluria plant enables greater feedstock flexibility for petrochemical producers, with potentially increased profitability

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New Demonstration Plant Moves Theory into Reality: Unlocking Code To Further Leverage Shale Gas Resources

For the last three decades, chemical companies worldwide have been working to develop a much-sought-after process to convert methane (natural gas) into ethylene, the world’s largest-volume commodity chemical, with global demand for 2015 estimated at more than 146 million metric tons, according to IHS Chemical. In April of last year, IHS Chemical issued a research note discussing the promise of an innovative new technology, called the Siluria process, which produces ethylene directly from natural gas through oxidative coupling of methane (OCM).

The La Porte demonstration plant is wholly owned by San Francisco-based Siluria, and co-located at a plant operated by Braskem America, Inc. The demonstration plant is the final scale-up of the OCM process technology and paves the way for Siluria to deploy commercial-scale plants.

The April 1 opening event was attended by the broad energy industry including Siluria partners – Braskem, Linde, Saudi Aramco, AMEC Foster Wheeler as well as IHS Chemical, the only industry consultancy included in the opening ceremony. Steve Lewandowski, global business director of olefins at IHS Chemical, was an invited speaker, discussing global ethylene production and developments, which have long been dominated by steam crackers, as well as the motivation to develop new technologies for addressing the global supply of stranded natural gas reserves. Additionally, this technology provides potential for converting methane to synthetic fuels.

Having followed this technology closely for a number of years, this technology—in terms of the science behind it—is only part of the story. It is the engineering and project development implementation of the science that
makes this particular Siluria process noteworthy and newsworthy. In the view of IHS, this is what makes it stand out from other revolutionary technology developers, and the difference between success and failure.

Essentially, for Siluria’s demonstration project, the fundamentals of the implementation have been really strong; the Siluria process is potentially a game-changer for the industry. Other companies are working on similar technologies, but no other company is at this level. That is no small accomplishment in a mature industry like petrochemicals, where major technological leaps forward are rare.

According to an April 1 Siluria Technologies’ news release, “this breakthrough was achieved using a combination of new innovations in catalyst development and advances in catalyst screening.” Said Ed Dineen, Siluria’s CEO, “This demo plant was brought in on time, under budget, and safely and successfully started up last December. The initial campaigns have already replicated our pilot scale performance.”

Siluria has previously announced its partnership with Linde to offer licenses to the ethylene industry worldwide. In interviews between Siluria personnel and IHS Chemical analysts regarding the project, Siluria estimates that at 1 million metric ton-per-year scale, Siluria’s technology would have a $100/ton cost.
advantage over ethane cracking and $350/ton for naphtha cracking. IHS estimates the ethylene cash-cost to be $515/ton when methane is $4.12/MM BTU.

Siluria has also scaled up production of the catalyst. This is crucial because this catalyst is quite different. Capex for the 1 metric ton-per-annum OCM demonstration plant is $15 million. Siluria is working with Linde to offer design for 75 thousand metric tons to 1 million metric tons-per-annum scale methane to ethylene plants.

According to the 2014 process economics report from IHS Chemical, which assessed the potential commercial viability and economics of this new petrochemical technology, our IHS analysis said that Siluria appeared to have unlocked the code, developing a patented process for the production of polymer-grade ethylene via oxidative coupling of methane. Now with the demonstration project in place, this announcement is still timely for producers seeking to further leverage an abundance of shale gas resources available in North America and other regions into essential petrochemicals.

The IHS report, entitled The IHS Chemical Process Economics Program: Review 2014-07, Oxidative Coupling of Methane (OCM) to Ethylene by Siluria Process, reviews the design and relevant economic performance of an ethylene plant based on Siluria’s OCM technology. Currently, ethylene, which is considered the workhorse petrochemical building block, is predominantly produced using high-temperature steam cracking of ethane and naphtha feedstocks.

Since the development of the steam-cracking process of higher carbon alkanes to produce ethylene and heavier olefinic co-products, all process developments have been evolutionary, not revolutionary in nature. That said, research and development chemists have investigated the elusive process of coupling the simple, one-carbon methane molecule to form an economically viable two-carbon ethylene molecule. Such a route has been technically and economically problematic with respect to yield, selection and process stability — due to high-reaction temperatures, and non-specific catalysts.

IHS believes that this simple, but elusive, chemical process route is much more likely to be achieved with development of Siluria Technologies’ catalyst and process technology for the highly selective oxidative coupling of methane to selectively form ethylene.

With the La Porte demonstration plant up and running, this process, according to the IHS technical and economic analysis, appears to be technologically feasible and commercially competitive as compared to naphtha cracking and even ethane cracking to ethylene when ethane/methane price ratios are above certain levels. This technology, when implemented on a commercial scale, could contribute to a global feedstock reshuffle for basic commodity chemicals.
A Cost-Effective Process that Generates Value-Added Co-products

IHS analysis suggests that the Siluria process will be cost effective at lower natural gas (methane) prices and at higher ethane prices. The economics suggest that OCM to ethylene is a capital-intensive process primarily driven by the cost of heat exchangers and compressors used in modifying the temperature and pressure of light gasses in the process.

However, the process also generates value-added co-products energy that reduce the effect of the raw material and utilities costs. Specifically, IHS estimates that (based on methane at $4.12/MM Btu) such credits reduce the raw material cost of $567 per metric ton of ethylene to a net variable cost of $426 per metric ton. When considering fixed cost, the plant cash-cost that IHS expects for a world-scale OCM-based ethylene plant is $515 per metric ton of production; and at $3/MM Btu is $420 per metric ton of OCM-produced ethylene.

With regards to implementation of this technology, countries with abundant, low-cost natural gas and with shale gas programs already in development will have a competitive advantage over countries that do not.

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Industry-specific insight alone is not sufficient to make decisions of great scale. Connecting the dots to reveal interdependencies between both adjacent and seemingly unrelated sectors is required. It’s at these connection points where the greatest risks and opportunities await.

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