PARTIAL UPGRADING COULD ADD VALUE TO ALBERTA BITUMEN AT A LOWER COST, BUT COMMERCIALIZATION STILL HAS A LONG WAY TO GO

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Gerald Bruce, like most people associated with the upgrading of bitumen, is encouraged by the Alberta government’s recent endorsement of partial upgrading. Against the backdrop of sub-$50 WTI and a barrel of bitumen selling at even less, partial upgrading is a compelling proposition because it has the potential to narrow the light-heavy oil differential, reduce or eliminate the cost of diluent in piping bitumen (which also effectively increases the capacity of the existing pipeline network for bitumen), reduce the overall carbon intensity of bitumen refining and provide better netbacks to oilsands producers. But oilsands producers won’t see any of these benefits through this downturn because commercial partial upgrading is still years away.

Also, the government’s $300 million of incentives—the details of which are still pending—may not seem like much to an industry more accustomed to thinking in billions.

Bruce, who is the president of GWB Process Consulting and holds the patent on Meg Energy’s Hi-Q partial upgrading technology, makes the point, however, that to get to a place where the industry can spend billions on commercial partial upgrading, it will need to first spend millions in the development stage.

“So in this sense, [the incentives are] pretty important,” he says.

WHAT COUNTS AS PARTIAL UPGRADING?

In most discussions, the timeline for commercialization of partial upgrading technology is anywhere from three to 10 years. Duke du Plessis, senior adviser, energy technologies with Alberta Innovates – Energy and Environment Solutions (AI-EES) and co-author of several studies of partial upgrading, expects the shorter timeline; Bruce expects the longer one. ➤
When asked why nobody talks about Imperial Oil’s paraffinic froth treatment at Kearl as an example of commercial partial upgrading that’s already in use, du Plessis explains that it doesn’t fully measure up to the criteria set out by AI-EES for partial upgrading because it still requires diluent and it doesn’t increase the value of the bitumen. “It’s not upgraded,” du Plessis says. The objective of partial upgrading is twofold. “You aim at reducing or eliminating diluent. The second thing is you improve the quality and market value of that crude. So if you get something like the deasphalted product in paraffinic deasphalting, it still has properties that aren’t valued by the client.”

MARKETS FOR PARTIALLY UPGRADED BITUMEN

As the research arm of the Alberta government, AI-EES started looking at full upgrading in 2004. When its research showed that more upgraders weren’t likely to be built in western Canada, it turned its attention to partial upgrading and, in 2012, published a competitiveness study that models the potential of partially upgraded bitumen crude (PUBs) in the PADD II U.S. refining market—where most Canadian oil ends up.

In 2015, AI-EES delivered a study of six global refining regions—Japan, India, China, Europe, Korea and the U.S. Gulf Coast—that shows these regions vary widely in their abilities to handle PUBs. European and Gulf Coast high-conversion and heavy-cooking refineries, for example, could readily accept medium quality PUBs. Slightly higher quality PUBs, however, could find considerable uptake in medium conversion and coking refineries in China as well as in the U.S. Gulf Coast and Upper Midwest.

All this is good to know but somewhat academic until pipelines connect Alberta to tidewater. So last year, AI-EES launched a study of the potential of PUBs in nine Eastern Canadian and Saskatchewan refineries. Those results are still pending but, as with other refining regions, PUBs could improve the economics and competitiveness of Alberta’s oilsands producers.

“The gross netback of partially upgraded products is substantial,” du Plessis says. “We found that the netbacks were tied more to the light-heavy differential and were less sensitive to the absolute value of the crude oil [pricing]... The value uplift derives almost 50/50 from the reduction of diluent and the added value of the bitumen component.”

Achieving the best economics, according to AI-EES, will require striking the right balance between oil quality—on a spectrum that starts with relatively low-cost solvent deasphalting and moves through to hydrotreating and hydrocracking—and minimal capital investment needed for this conversion.

“If you go past that peak, you’re spending money on a plant that you’re not getting value from,” du Plessis says. “How much capital a company can afford to invest to realize an increased netback will be a function of a producer’s capex intensity and its internal rates of return.”
TECHNOLOGIES THAT TAKE BITUMEN TO END PRODUCTS

If Imperial Oil's deasphalting process is at one end of the spectrum that doesn't quite reach into the "partial upgrading" category, there are also number of proponents that overshoot the category on the other end. These include Value Creation, Field Upgrading and Bayshore Petroleum. All of these are now aiming at refined end products.

Bayshore has teamed up with E-T Energy to deploy Bayshore's chemical catalytic conversion technology for in situ bitumen extraction at E-T's Poplar Creek oilsands property. Bayshore, however, also claims its catalyst technology can convert bitumen straight to diesel—and at an astonishingly low cost of $8,000 per flowing barrel, compared to an estimated $160,000 per flowing barrel at the Sturgeon Refinery Project being built by the North West Redwater Partnership.

Value Creation initially said it wanted to produce a "cleaned" sour synthetic crude that is more easily refined but has since moved up the ladder to a "clean oil refinery [model] that can produce—most cost effectively—very high quality light fuel products as well as premium medium crudes that not only fit the majority of refineries in North America, and eventually globally, but also enhance their refinery margins," says Columba Yeung, chair and chief executive officer of Value Creation.

Another company lumped in as a partial upgrader is Field Upgrading. Its technology is a step out from the usual deasphalting and thermal cracking approaches. It uses molten sodium to upgrade bitumen into bunker fuel, which is aimed squarely at an emerging market for low-sulphur heavy oil in ocean shipping.

According to marine industry data, just 15 of the largest ships in the world produce more pollution than all the cars in the world. This is because ships burn high-sulphur heavy oil, and regulators are cracking down.

"We can take high sulphur heavy oils, like bitumen, remove the sulphur and sell the low sulphur product into the marine fuel oil market at low sulphur diesel prices. It's a 'Bitumen-to-Boats' business," says Neil Camarta, president and chief executive officer of Field Upgrading.

By year end, Field Upgrading expects to have its Fort Saskatchewan pilot proven and to have completed a design-basis memorandum for a 10,000-bbl/d commercial project.

PARTIAL UPGRADE SYSTEMS

MEG Energy's Hi-Q process, Ivanhoe Energy's HTL technology (the company is now bankrupt), ETX Systems' TQ process, and the partial upgrading approaches of Fractal Systems and Petrosonic Energy are some of the partial upgrading approaches vying for commerciality in Alberta. 

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“The technology that will prevail is going to be the one that is USEFUL AT THE LOWEST ENERGY INTENSITY/CARBON FOOTPRINT.... There isn’t one answer here but multiple answers.”

—GERALD BRUCE, president of GWB Process Consulting and holder of the patent for MEG Energy’s Hi-Q process

ETX Systems’ technology is an example of “almost the highest quality [PUB],” says chief executive officer Gerard Monaghan.

“We believe that finding the most accretive mix is full coking of the bottom of the barrel, but without the addition of any hydrogen. Refiners are much better positioned in terms of infrastructure and proximity to end markets to provide the hydrogen piece of the upgrading puzzle.”

Interestingly, Monaghan envisions a significant role for rail in the transport of PUBs because the olefins produced in partial upgrading can make it difficult to meet pipeline specifications. He says that rail facilities could be repurposed to serve intermediate partially upgraded bitumen.

“With rail, you are naturally segregated, so I see that as a growing and enabling potential for rail...[because] partially upgraded products like ours have no flashpoint concerns and will float on water,” he says, referring to the tragedy at Lac-Mégantic, Que., and the concerns over bitumen sinking in ocean and waterway spills.

Monaghan says ETX’s technology has good traction with some midstream partners and plans are being made for a 14,000-bbl/d demonstration project.

“I’m cautiously optimistic that we will be able to access the funding we need to move forward in the next couple of months,” he adds.

GWB Process Consulting’s Bruce groups Ivanhoe’s HTL (if the technology is bought and pursued by another company), MEG’s Hi-Q and the technologies proposed by Petrosonic and Fractal into a diluent-avoidance group.

“Petrosonic was able to prove that a small reduction in asphaltenes by separation translates into a reduction in the diluent needed in the pipeline,” Bruce says. “Petrosonic wasn’t able to achieve diluent elimination. It was diluent reduction, and that is very similar to where Kearl ended up.” He also notes that Petrosonic is a technology company that is currently focusing on other projects.

Fractal Systems has been piloting its JetShear technology in the field since 2009, first with a 300 bbl/d facility near Consort, Alta., followed by a 1,000 bbl/d commercial scale demonstration near Provost. It is designed to reduce diluent requirements as much as 50 per cent by heating diluted bitumen just below thermal cracking temperatures and pumping it through proprietary jet-nozzles where cavitation and mechanical shearing occurs. The company says that between April 2014 and April 2015, it processed over 100,000 barrels of diluted bitumen, successfully proving the base technology.

Fractal director Joe Gasca says the technology is primarily focused on diluent reduction but the process also results in some partial upgrading. He says Fractal is working to get in front of Alberta government representatives to better understand the partial upgrading incentive opportunity. Meanwhile, Gasca says the company is nearing completion of a retrofit at its Provost facility and that for the remainder of this year will pilot a new configuration called Enhanced JetShear. Also being piloted is their Acid Reduction Process, another technology system designed to specifically address high-TAN crudes. Enhanced JetShear plus ARPTM has been designed to reduce diluent by as much as 60% and reduce TAN to below 1 mgKOH/gr.

Bruce believes the best partial upgrading options target wide-spectrum crude refineries, such as those found in Eastern Canada and the U.S. Midwest. This approach has the potential to strike the right balance between crude quality improvement and minimal investment, while avoiding competition with Bakken light oil for refining capacity.

“The technology that will prevail is going to be the one that is best suited to make products that are useful at the lowest energy intensity/carbon footprint,” Bruce says. “It’s a long-term process, but it’s strategic as well. You’ve got another 800,000 or 900,000 barrels of production coming on over the next two years. How you respond to this can be through partial upgrading, which gets you in the right direction, but you might want to also consider conversion to finished products and putting those on rail cars to get to market. So there isn’t one answer here but multiple answers.”