

INVESTING FOR LONG-TERM TRENDS

The start-up of two new Shell-licensed hydrocrackers is helping Valero Energy Corporation to export more high-quality, high-value diesel from converting low-value vacuum gas oil and low-cost US natural gas to meet the rapidly growing demand from the European and South American markets.

Being in the right place at the right time to meet an upsurge in market demand can sometimes be down to good fortune. Sometimes, however, it is the result of careful planning and a

thorough understanding of long-term market fundamentals.

For Valero, its decision to invest more than \$3.2 billion in the construction of two major-scale hydrocrackers containing the latest Shell Global Solutions hydrocracking technology and state-of-the-art catalysts from Criterion Catalysts & Technologies (Criterion) has been validated.

The organisation brought a new 50,000 barrels-a-day hydrocracker at its Port Arthur refinery in Texas, USA, online in December 2012. Some seven

months later, in July, the organisation started up a second hydrocracker at its St Charles refinery in Louisiana, which also has a nameplate capacity of 50,000 barrels a day. Both hydrocrackers have met all the process guarantees regarding throughput, product yields and product quality, and they have been able to achieve throughputs of up to 60,000 barrels a day: 20% more than their basis of design.

The refiner had identified a series of long-term trends that came together to put it in the right place at the right time. The planning for the two hydrocrackers began



before the global economic downturn but, when many refiners cancelled major capital projects, Valero management kept both projects alive. It did, however, slow them down from November 2009 before bringing them back up to full speed in January 2011.

Several factors fell into place. Hydrocrackers need large quantities of hydrogen to produce ultra-low sulphur diesel, which Valero can generate from natural gas. The abundance of gas extracted from US shale deposits in recent years has led to a significant natural gas price collapse, which is why John Roach, Senior Vice President of Strategic Development and Technology, Valero Energy Corporation, calls these ventures "gas-to-liquids" projects.

"These projects were very significant investments," says Roach. "Although Valero routinely invests heavily to the tune of \$3 billion per annum, they were the largest capital projects that Valero has ever approved in its company history."

He explains that the hydrocrackers produce diesel with a cetane index that far exceeds the EN 590 specification for ultra-low-sulphur diesel. This cetane giveaway is significant, he says, because refiners and fuel blenders can use Valero's diesel to blend their own products up to EN 590.

For the project to succeed, all these factors had to come together. Shell Global Solutions and Criterion were then able to add the essential technical hydrocracking process and catalyst expertise, which Roach says was vital.

"We always have had an outstanding relationship with Criterion, as its catalysts have been in our plants for many years. However, this was the first time that we had worked with Shell Global Solutions in building a large capital project of this size. We chose them because they had a competitive licensing package and leading-edge unit reliability, and we felt that they fielded a very strong project team."

Valero is not alone in recognising the momentum in global dieselisation, although its response has been decisive and large scale. Whereas US refiners have traditionally had a two-to-one output ratio for gasoline and diesel, the company will soon produce as much distillate as gasoline, largely as a result of these strategic hydrocracking projects.

The potential implications of this trend for refiners, which are already coping with a changing feedstock slate and increasingly stringent environmental standards, are profound. Many are leveraging hydrocracking technology; industry analysts recently estimated that global hydrocracking capacity had increased by 40% in three years as a leveraged response.

The Valero hydrocracking units at Port Arthur and St Charles have a unified design. They have a two-stage configuration loaded with Criterion's next-generation CENTERA® catalyst for hydrocracking pretreatment and a state-of-the-art hydrocracking catalyst from Criterion's affiliate Zeolyst International.

Both units process about 60,000 barrels a day of high-sulphur vacuum gas oil (VGO), sometimes with a small proportion of heavy

coker gas oil, to produce 44,000 barrels a day of distillates, 24,000 barrels a day of gasoline and blend stocks, 3,000 barrels a day of liquefied petroleum gas and 1,000 barrels a day of low-sulphur VGO.

The total output is, therefore, about 72,000 barrels a day – some 20% more than the feed to the unit. This liquid-volume expansion, which primarily comes from the hydrogen saturation that occurs in the high-pressure, high-conversion design, is key to the project's economics, as it helps the refinery to maximise its distillate yield.

Valero's approach to these projects can be characterised as design a plant once, build it twice and then increase performance further by cost-effective debottlenecking. Increasing the capacity of these units is helping to enhance the project's economics, as Roach says that the organisation has customers for every barrel that it makes. Moreover, its hydroprocessing experts expect to be able to squeeze more output – and value – from the units.

"In technical terms, they are also a success. The hydrocrackers have a good design, they are operating well, running consistently at about 60,000 barrels a day and producing high-quality diesel: we are very happy with that," he concludes.

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