

Increase diesel yields — and profits — for your refinery

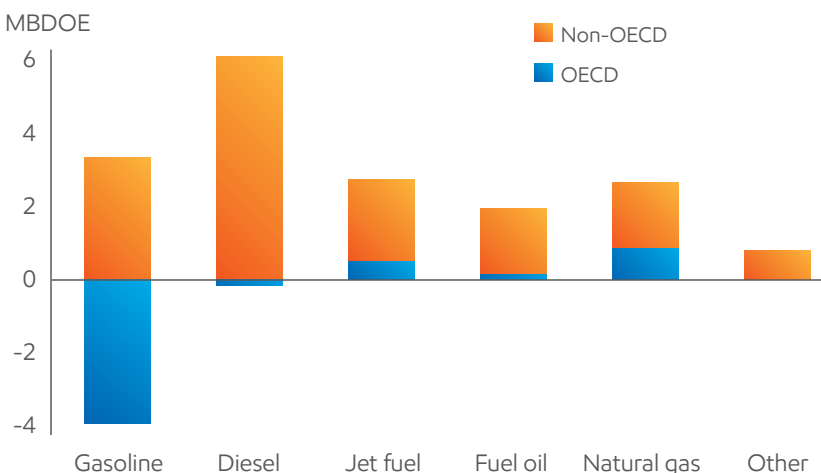
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It's no secret within the industry that global demand for diesel fuel is growing and likely will continue to grow significantly in the years ahead as developing markets continue to expand (Figure 1). Smart refiners are looking for ways to seize the opportunity to increase their production — and their profitability.

Many of them, however, are leaving money on the table by relying on production methods that don't ensure the maximum yields of high-quality diesel, especially when refining waxy, high-paraffin crudes. These methods are hindered further by tighter specifications in cold climates, where vehicles need

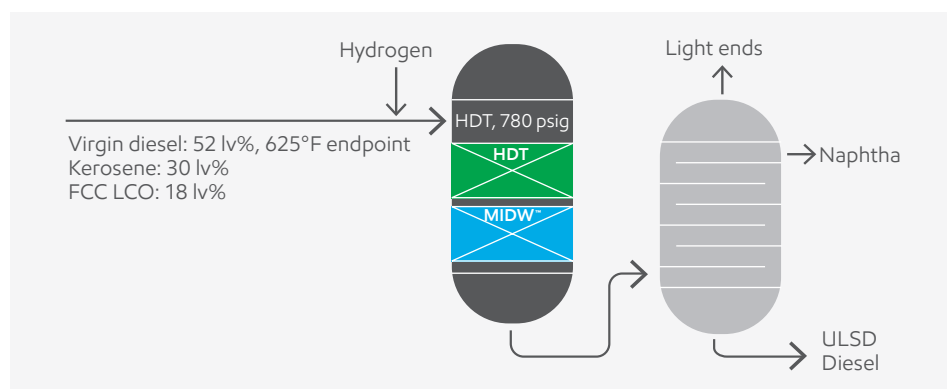
Figure 1: Incremental transportation fuel demand forecast* from 2015 - 2040



MBDOE – million barrels per day oil equivalent
OECD – organization for economic cooperation and development

*Source data: 2017 ExxonMobil Outlook for Energy

Figure 2: HDT configuration



Rate/Properties (Winter)	HDT feed	HDT product	Pipeline specification
Charge, kbd	50	48.8	--
Specific Gravity	0.843	0.840	
Sulfur	0.25 wt%	<10 ppm	<10 ppm
Pour point, Deg F	-5.2	-5.2	-5.0
Cloud point, Deg F	0	0	10
T90% off, Deg F	578	578	640

diesel that can perform in winter or even arctic conditions. To increase their yields and their profits, refiners should consider a different, more effective option that may improve their overall product value.

Common production methods

Refiners typically increase diesel production by raising the boiling range of the diesel hydrotreater feed to the limit of the diesel fuel specification. This method, however, can introduce cold-flow property issues, because heavier feeds contain higher molecular weight paraffins. To meet cold-flow specifications, refiners often use a few approaches, such as:

- Blending treated kerosene into the diesel pool
- Routing untreated kerosene to hydrotreater (HDT) feed
- Undercutting diesel endpoint
- Catalytically removing paraffin from the diesel (cracking)

These traditional options have drawbacks that undermine profitability. The first two options can limit the amount of jet production, which usually has a higher value than kerosene or diesel. Kerosene-to-diesel blending may be limited by other properties, such as flash point, and kerosene volume blending limitations may curtail the total diesel production. Undercutting diesel cutpoint can degrade diesel to vacuum gas oil (VGO), which also may reduce the gasoline-to-diesel flexibility for the refiner. In short, using these approaches can mean losing profits.

A better option

ExxonMobil Catalysts and Licensing offers an effective way to modify the cold-flow properties in diesel: MIDW™ technology for isomerization dewaxing of distillate fuels. It's a relatively simple drop-in catalyst solution for dewaxing diesel that efficiently uses existing plant equipment.

The MIDW catalyst enables production of high cetane and low cloud and pour point diesel at higher yields, allowing refiners to increase the diesel endpoint and reduce or eliminate the need for kerosene blending to meet the cold-flow properties. Through MIDW technology, they can:

- Reduce cloud point — a change of 54°F (30°C) is achievable
- Increase diesel retention — yields as high as 98 percent, depending on cloud point
- Meet Euro V/VI quality

Based on shape-selective zeolites, the first version of MIDW catalyst was commercialized in 1990. Since then, higher-performing grades of MIDW catalyst have been developed, drawing upon ExxonMobil's catalyst, process engineering and operational expertise to deliver the highest value. Not only has MIDW catalyst been installed in over 15 units worldwide, it is also used within ExxonMobil's global refining circuit, and interest is growing among refiners seeking a proven solution.

Opportunity in action

A refiner processing light sweet crudes that contain a moderate to high paraffin content, for example, could use MIDW technology to increase diesel yields. To meet diesel cold-flow property specifications in winter, this refiner could be undercutting the feed endpoint to a single-reactor diesel HDT (Figure 2) and keeping the unit hydraulically full by routing kerosene to HDT feed.¹

By using MIDW catalyst, which would lower cloud point by 21.6°F (12°C), this refiner would have the flexibility to increase the HDT feed endpoint (T95%)

1. The MIDW™ technology and catalyst can be customized for a variety of single or multiple reactor configurations.

by 62°F (34.4°C) — the equivalent of backing out 12 kbd of kerosene from HDT feed, while meeting cold-flow properties.

The rebalancing of kerosene with heavier diesel in the HDT feed would result in a profit improvement of as much as \$20M/year. The refinery also now would have incremental swing capability between gasoline and diesel production by adjusting diesel endpoint to meet market demands. The HDT unit impact with MIDW™ technology is shown in **Figure 3**.

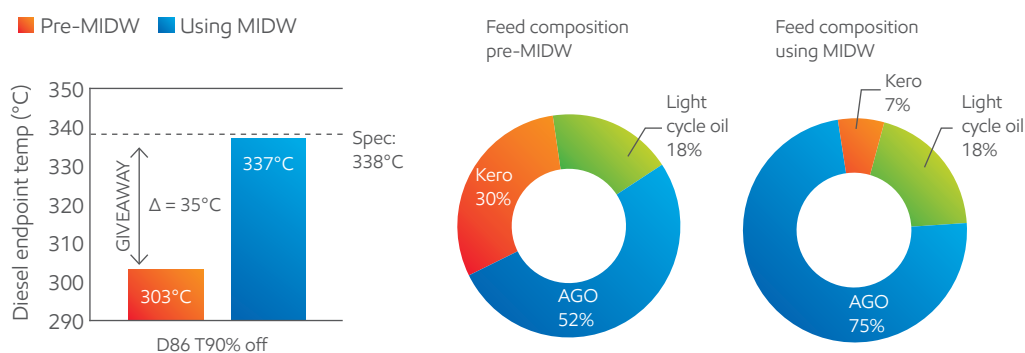
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The economic analysis shown in **Figure 4** is based on historical trade of liquified petroleum gas (LPG), naphtha, kerosene, heavy atmospheric gas oil (HAGO), light cycle oil (LCO) and ultra low sulfur diesel (ULSD) to West Texas Intermediate (WTI) crude.

Refiners seeking a more profitable method for meeting diesel specifications need to consider the advantages of MIDW technology. The increase in profitability and rate of return on their investment can be pleasantly surprising.

Figure 3: Refinery yields with MIDW™ technology applied

Refiner's projected net benefit from ExxonMobil MIDW technology: \$20M/yr+
Feed rebalancing: Uplift atmospheric gas oil (AGO) to diesel, and more kero to jet fuel



HDT feed basis Volume %	Base case	With MIDW™	Delta Vol%
Virgin diesel	52	75	23
Kerosene	30	7	-23
Fluid catalytic cracking – light cycle oil	18	18	0

Figure 4: Economic analysis

Business cases	Cold property modification	\$M/yr
Base case	Pour point can limit virgin diesel cutpoint; T95% off at 625°F	Base
MIDW™ case	MIDW could go beyond 70°F of cutpoint in diesel, lowering pour point and cloud point by more than 21.6°F	20

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