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For refiners, hour to reinvent is nigh

Investments in petrochemicals can provide some offset to the inevitable long-term loss in transportation fuel demand

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Hour to reinvent the business model

The revenue model of refineries is typically based on optimum capacity utilisation and maximum production of fuels such as petrol and diesel.

Profitability is determined mainly by gross refining margins (GRMs), which, in turn, is a function of the price of crude oil and petroleum products, and the demand-supply scenario.

Petroleum product 'spreads' were healthy in the past because of strong demand from the transportation sector in both developed and developing economies.

However, recent volatility in crude oil prices has meant spreads haven't increased apace with crude oil prices, leading to shrinking GRMs.

Moreover, regulatory pressure and technological advancements – such as the increasing use of electric vehicles – have led to greater use-case efficiencies that have had a bearing on demand growth for transportation fuels.

Refiners are therefore trying to reinvent themselves through diversification and revenue-stream expansion by producing more value-added products such as basic petrochemicals.

Robust growth potential for petrochemicals

Petrochemicals account for nearly 30% of the Indian chemicals industry. Over the past decade, domestic demand has grown at a compound annual growth rate (CAGR) of 8-9% due to increasing consumption of plastics driven by a rise in substitution and new uses.

And in the past five years, domestic demand has logged a 7-8% CAGR as demand from end-use applications such as packaging, automobiles, and electricals and electronics remain healthy.

Capacities for ethylene and propylene constitute nearly 80% of the total capacity for basic petrochemicals. The performance of the petrochemicals industry is often benchmarked to ethylene.

Growth in polymers is largely linked to the economy. With India's GDP growth expected to be healthy over the long term, polymer demand will tango, driven by the packaging, automobiles, consumer durables, construction, and irrigation sectors.

India's per capita consumption of plastics is only about 10 kg compared with the global average of ~30 kg, which underscores the enormous potential for polymers.

Demand growth could also arise from continued substitution of metal pipes, and glass and metal containers with plastic ones. Increasing use of plastics for packaging due to their superior quality and cost-effectiveness will also prop demand.

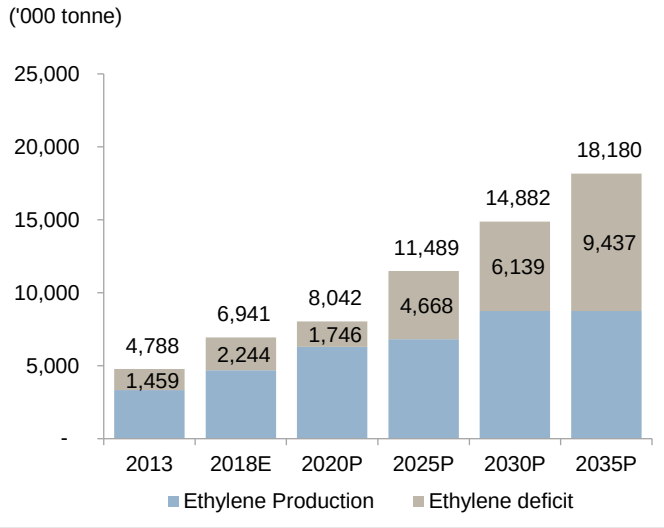
Consequently, CRISIL Research expects domestic demand for ethylene (primarily driven by polyethylene [PE] and monoethylene glycol [MEG]) and propylene (driven by polypropylene as well as other propylene derivatives), to grow at a CAGR of 7-8% between fiscals 2018 and 2025.

Between fiscal 2025 and 2030, domestic demand would grow at 4-5%.

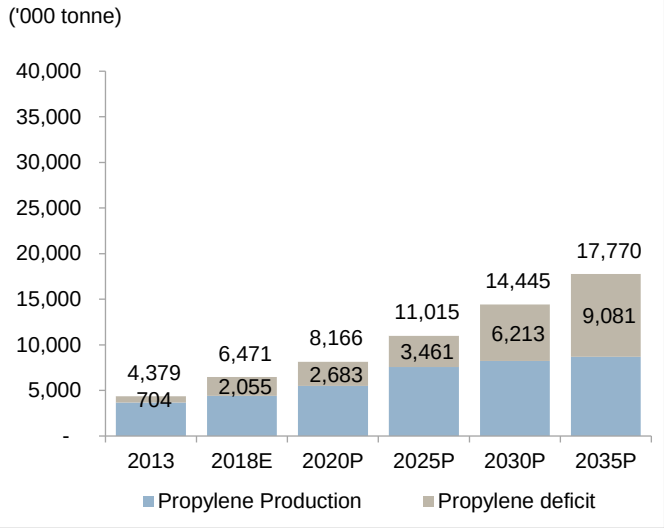
Ethylene and propylene capacities needed to bridge demand-supply gap

By 2030, domestic ethylene demand from major end-use segments such as PE, MEG and polyvinyl chloride (PVC) is expected to reach ~15 million tonne. Domestic ethylene capacity, however, may not keep pace. Supply is expected to touch ~9 million tonne by 2030, resulting in an ethylene deficit of 6.1 million tonne, which will gradually increase to 9.4 million tonne by 2035 in the absence of capacity additions.

Domestic ethylene demand-supply mismatch



Domestic propylene demand-supply mismatch



Source: CRISIL Research

Propylene deficit presents a similar case as ethylene. By 2030, domestic propylene demand is expected to be 14.5 million tonne, but capacity would lag. Supply is expected to be ~8 million tonne by 2030, leading to a propylene deficit of ~6 million tonne (assuming self-sufficiency), which will gradually increase to 9 million tonne by 2035 in absence of capacity additions.

Import dependence on polymers = huge scope for capacity additions

India is a net importer of most polymers. Over the past 10 years, imports have increased at ~15% CAGR as domestic capacities lagged demand. The import dependency for PE, polypropylene (PP) and PVC was 37%, 20% and 55%, respectively, in fiscal 2018.

Lack of olefin capacities in India has also resulted in limited production of other downstream chemicals. For example, India is a net importer of propylene derivatives. Of the total propylene production, more than 95% is used to make PP. Given concerns over availability of feedstock propylene, players are apprehensive about adding downstream capacities for propylene derivatives.

This demand supply mismatch opens up a huge opportunity to add capacity in downstream chemicals. Integrated refining and petrochemical players would be in a better position to take advantage of strong demand potential in petrochemicals and other chemicals.

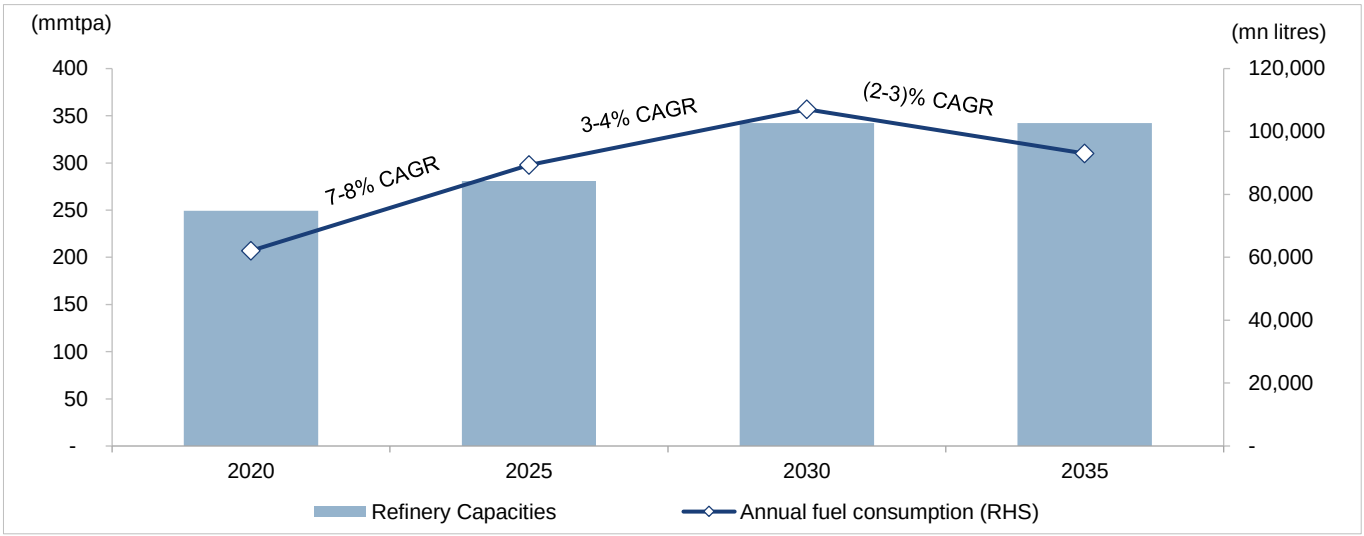
Loss in fuel demand inevitable in the long run; Investments in petrochemicals can provide some relief to refiners

Traditionally, refineries were set up to produce transportation fuels such as petrol and diesel. The economics of refineries, as discussed earlier, is based on sale of petrol and diesel, and technology to maximise production. Reason why petrol and diesel form a chunk of crude oil derivatives globally.

But the move towards alternate technologies with the aim of reducing carbon emissions will increasingly impact demand for transportation fuels. From a 10-year horizon, the impact of electric vehicles may not be significant on oil demand, but further out, it could change the game.

Thus, while we expect fuel demand to peak by 2030, improvement in fuel efficiency and increasing penetration of electric vehicles will act as curbs thereafter. The subsequent loss in fuel demand would translate into lower revenue potential from gasoline and diesel, and consequently, reduce earnings for refineries. Therefore, it is imperative for refiners to explore alternate revenue streams.

Slowdown in fuel demand over the longer run



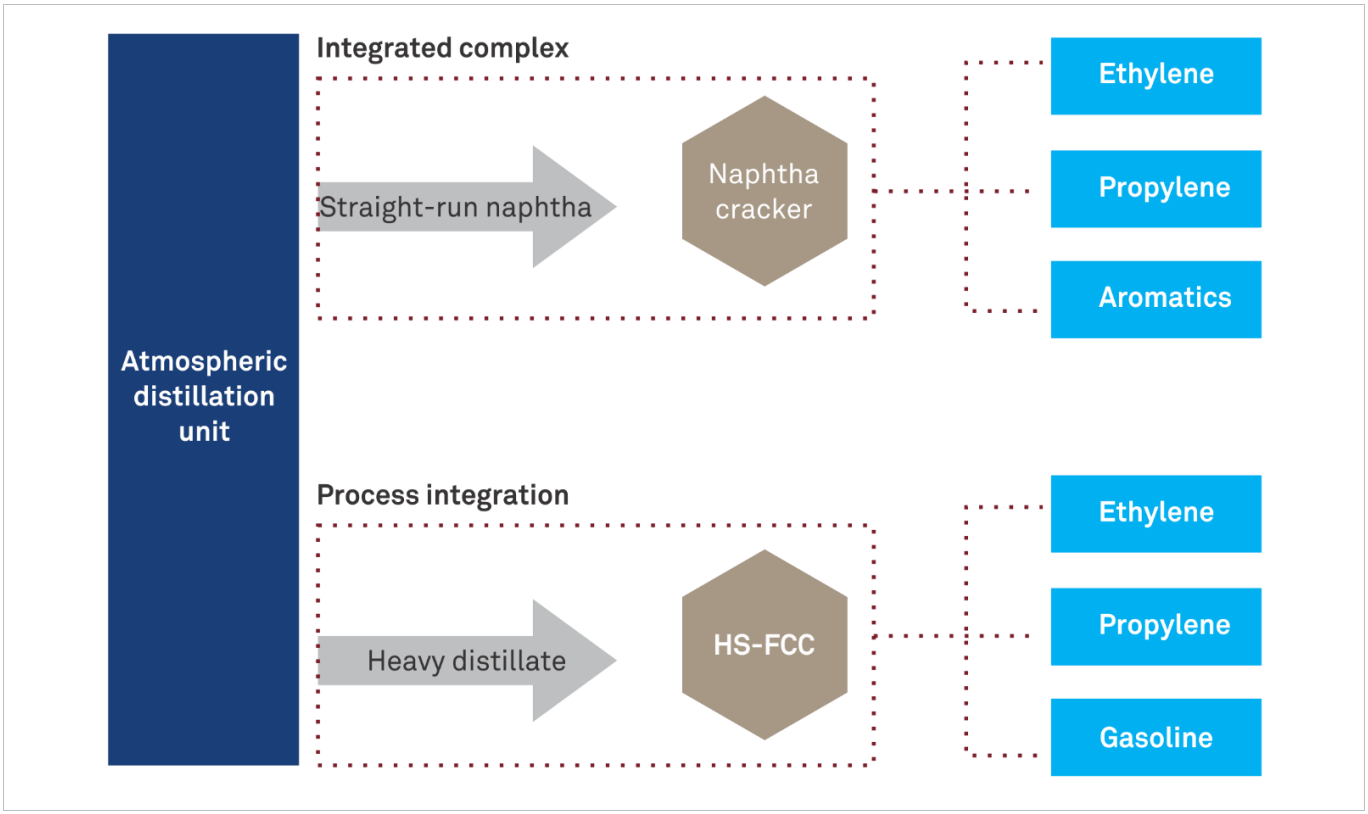
Source: CRISIL Research

Forward integration with petrochemicals can partially offset pressure on GRMs

With slowdown in fuel demand inevitable over the long run, the subsequent narrowing of product spreads will crimp GRMs, too. While integration with petrochemicals will not be a complete offset, it will help refineries diversify revenue streams and enjoy healthy margins.

For the purpose of this study, we have evaluated two key methods of integration:

1. Integrated complex with steam cracker
2. Process integration through HS – FCC



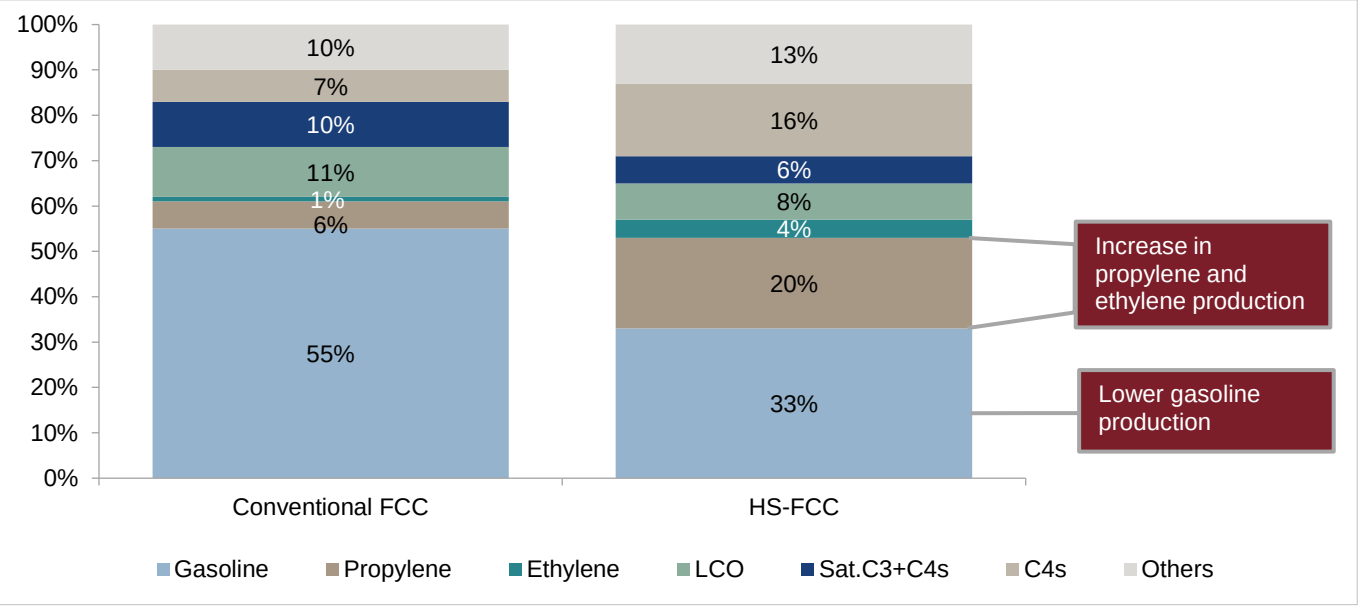
Source: CRISIL Research

Integration of refineries with petrochemical complexes can enable usage of traditional refinery streams in petrochemicals complexes. Moreover, it will also provide a source of higher revenue while possibly reducing operating expenses because of economies of scale, process optimisation and infrastructure sharing.

Further, non-monetised by-products from the petrochemicals unit can also be used in a refinery. For example, hydrogen and methane are produced in a steam cracker as a byproduct along with ethylene and propylene. Refineries are typically dependent on natural gas to meet their hydrogen requirements. However, with integration, the operating expense of refineries can be reduced by streamlining the hydrogen generation process.

Further integration can be aided by advancements in technology, such as high severity fluid catalytic cracking (HS-FCC), which can produce much higher volumes of olefins (over 25% compared with less than 10% in conventional technologies). With HS-FCC, higher proportion of chemical products are produced, relative to gasoline products.

Comparative yields of conventional FCC vs HS-FCC



Source: Company reports, CRISIL

If we look at the domestic refinery expansion/ additions going forward till 2030, most of them are integrated with petrochemical units. Increasingly, new refineries are concentrating on maximising propylene slate with HS FCC to meet domestic propylene requirements.

List of refinery expansion/ additions

Name of Refinery	Planned Expansion (MnTPA)	Tentative commissioning year	Whether integrated with petrochemicals
IOCL, Panipat (Phase - 1)	5	FY 24 (Announcement)	No
IOCL, Panipat (Phase - 2)	5	FY 28 (Announcement)	No
HPCL, Rajasthan	9	FY 26 (PFR done)	Yes - Dual feed cracker, FCC
HPCL, Visakh	6.7	FY 22 (Work underway)	Yes - FCC
CPCL, Narimanam	9	FY 26 (Announcement)	No
IOCL, Barauni	3	FY 23 (Board approval)	Yes - FCC/ PRU
NRL, Numaligarh	6	FY 23 (Board approval)	No
BORL, Bina (Phase - 1)	1.8	FY 20 (Work underway)	No
BORL, Bina (Phase - 2)	7.2	FY 26 (Announcement)	No
HPCL, Mumbai	2	FY 21(EC Received)	Yes - FCC
Western Mega Refinery (Phase -1)	20	FY 26 (PFR done)	Yes - FCC
Western Mega Refinery (Phase -2)	20	FY 29 (PFR done)	No

Source: Company reports, CRISIL

Further investments in HS-FCC required to meet the propylene gap

Of the 92 million tonne refinery capacities planned till 2030, only 30-35% have planned an HS-FCC unit to produce olefins. However, for India to be completely self-sufficient in propylene, HS-FCC capacity (producing up to 13-15% propylene) of 50-60 million tonne is necessary.

Considering that an FCC unit is typically one-third of the total refining capacity, effectively, refining capacity of 150-180 million tonne needs to be configured to produce olefin rich chain from FCC route.

This means of the total 342 million tonne of refining capacity by 2030, nearly 45-50% needs to have HS-FCC units (as of now, only ~35% are expected to have).

Expected loss in fuel demand by 2035 further supports investment in HS-FCCs

By 2035, we expect nearly 55-60 million tonne of loss in fuel demand owing to penetration of electric vehicles and improvements in fuel efficiency.

Nearly half of that loss can be offset by increasing the oil to chemical ratio of a refinery, which, in turn, can be achieved by integrating investments in crackers and HS-FCC.

Increasing the yield of naphtha in a refinery and integrating the refinery with a steam cracker can provide a rich and diversified petrochemicals chain.

Currently, slate of naphtha in a refinery is around 6-8%. However, if this is increased to 10-12%, and investments in dual-feed crackers are made, it can narrow the domestic ethylene demand-supply gap.

Moreover, with an HS-FCC, the slate of motor spirit (MS) can be reduced by nearly 20%. This, in effect, can bring down MS slate of refinery from 15-17% to about 11-13%. While this will not completely offset the expected loss in fuel demand, it will provide some relief.

The fundamental threat to refineries from loss in fuel demand will continue

Petrol and diesel typically account for over 50% of the overall refinery slate (The Jamnagar refinery of Reliance Industries Ltd [RIL] is an exception as the slate of petrol and diesel there is ~35%. RIL has emphasised on increasing the oil to chemicals ratio at the refinery). With slowdown in fuel demand and reduction in GRMs, refineries are staring at profitability risk.

This calls for major technological advances in the refinery and petrochemicals industry.

An emerging trend globally is the crude-to-chemicals complex, wherein the processes of refinery and petrochemicals are merged. The objective of this technology is to shift the products derived from a barrel of oil from the traditional 15% - 25% to 40% - 80% range of chemical feedstocks and non-fuel products.

For example, ExxonMobil, the US giant, has commissioned a world-scale facility in Singapore in 2014 that produces 1 million tonne per year of ethylene directly from crude oil.

And Saudi Aramco and SABIC have also announced a large crude-to-chemicals projects, five times Exxon's in Singapore. Several such projects are being constructed or planned in Saudi Arabia and Asia, and have the potential to reshape the global petrochemical industry.

Similarly, there is a need for refiners in India to reinvent themselves and cater to the needs of additional demand centres such as petrochemicals and other chemicals.

Given the potential loss in fuel demand, the way forward is further integration of refineries with petrochemical units, and not just co-located refining and petrochemical plants.

The message is clear: while loss in fuel demand will impact GRMS, the opportunity in petrochemicals and downstream chemicals is up for grabs.

Integration will not only meet the domestic chemical demand-supply gap, but also push the refining sector towards optimisation despite loss in fuel demand by diversifying their portfolio.

For an underpenetrated chemical market such as India, the revenue potential for new players setting capacities is enormous.

Will the refineries take advantage of the opportunity?

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